BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(19) Europäisch s Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 268 237 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 87116861.3

(22) Date of filing: 16.11.87

(51) Int. Cl.⁴ G01N 1/10 , G01N 35/00 , G01F 11/02

(30) Priority: 17.11.86 US 931476

(43) Date of publication of application:
25.05.88 Bulletin 88/21

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: **ABBOTT LABORATORIES**
Abbott Park Illinois 60064(US)

(72) Inventor: **Hayes, Donald J.**
2012 Tampicko Drive
Plano Texas 75075(US)
Inventor: **Wallace, David B.**
9929 Wood Forest
Dallas Texas 75243(US)
Inventor: **Verlee, Donald J.**
563 Drake Street
Libertyville Illinois 60048(US)
Inventor: **Houseman, Kenneth R.**
1520 S. Main Street
Racine Wisconsin 53403(US)

(74) Representative: **Modiano, Guido et al**
MODIANO, JOSIF, PISANTY & STAUB
Modiano & Associati Via Meravigli, 16
I-20123 Milan(IT)

(54) Apparatus and process for reagent fluid dispensing and printing.

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing recepticle.

EP 0 268 237 A2

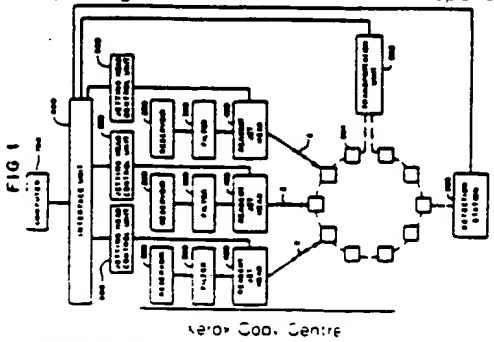


FIG 1

APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined lev l indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the define volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volumes dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three w ll known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desir d configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not exposed to light, when develop d, become porous. However, the areas of the screen which have been exposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the scre n and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermin d pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test strip.

The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against the test strip to transfer the reagent, in the same pattern, to the test strip.

Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process. Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproduceable minute quantities of reagent on the test strip.

It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

SUMMARY OF THE PRESENT INVENTION

The present invention is directed to a reagent dispensing and printing apparatus and method, wherein the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid recepticle. If desired, additional droplets may be deposited in the recepticle or the recepticle aligned with an additional jetting tube for receiving an additional reagent fluid.

An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reag nts do not in general have to be specially adapted for use with the present invention.

The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets 2 of reagent fluid. The droplets 2 are propelled, with controlled velocity and direction, towards a selecting mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezeo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply type 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to the housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into the transducer chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with respect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into the transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the respective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold the jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the differing constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also expand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the orifice causing reagent fluid to be dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satellite droplet. However, even if satelite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproduceable. This reproduceability allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay results.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproduceably eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. The ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the present invention overcomes this disadvantage.

In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an interface 600, a computer 700, and an x-y plotter 800.

The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER*, LOWER* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT* and the inverters U103-U105 invert the control signals LOWER*, HIGHER*, and RST signals, respectively.

The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a reservoir R13, connected to the -15 volt supply, and a diode CR6, connected to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifier U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground potential.

The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the base of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the +15 voltage supply through the

transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output V++. A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output V++ is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT*, LOWER*, HIGHER*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to ennance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input REF(+) of the D/A converter U30. The negative voltage reference signal input REF(-) is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT* which are proportional to the difference between the positive and negative voltage reference signal inputs REF(+), REF(-). Capacitors C48, C49, C50 are connected to the D/A converter U30 to ennance stability.

The D/A converter outputs IOUT, IOUT* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER*, HIGHER* and RST. The LOWER* signal and the HIGHER* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT* are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the invert ing input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of th amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V+ +.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the voltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a on - shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation aand duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of the transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the catnode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issues a series of commands, through the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then the HIGHER* signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER* signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line.

Once the control unit 500 and the plotter 800 are initialized, the printing cycle may begin. The computer 700 issues a command to the interface unit 600 to produce the series of PRT* signal pulses. The computer 700 then commands the plotter 800 to print, for example, a line along a selected path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the expiration of the

delay, the signal is AND d with the closed enable switch S1 and the seri s of print pulses PRT'. The result of the AND operation is the application of the PRT' pulses to the pulse generator circuit 530.

The PRT' signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT'. The two outputs IOUT, IOUT' are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U28 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propell d onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satelite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the momement of separation from the orifice 433. Corrections based on the observation may then be made to the system 10.

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of flow viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the transducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schematically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally close three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirer unit 990. This is especially useful for reagent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertures 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from the housing position 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transducer 434". The transducer 434" is

held in position by a hold down plate 402" attached to the housing 403". The electrical connections to the transducer 434" are of conventional design and are therefore not shown. The housing 403" further comprises a threaded aperture 406" for mounting the jetting head 400".

The jetting head 400" operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434" is normally disk shaped. When the electrical pulse is applied, the transducer 434" bends slightly, thereby altering the volume of the conically shaped jetting chamber 432". The change in volume of the chamber 432" causes the expulsion of fluid through the orifice 433" and the intake of fluid through the supply channel 430" as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400" . The jetting head 400" is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400" comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409" and screws, not shown. When assembled, the housing sections 404", 402" form a T-shaped supply channel 410" .

In operation, the jetting head 400" functions in a manner similar to the jetting head 400. The jetting head 400" is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430" allowing the jetting tube 432" to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11E. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Billerica, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a syringe. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to th r servoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):

Fluid viscosity range: 1 - 30 centipoises

Fluid surface tension: 20 - 70 dyne/cm

Printing (continuous mode):

Fluid viscosity range: up to 50 centipoises

Fluid surface tension: not measured

Dispensing (drop on demand mode):.

Fluid viscosity range: 2 - 30 centipoises

Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satelite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satelite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found esp cially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycenn substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is expelled from the orifice.

When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 knz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
R39,45-48,57, 58	RES.10KOHM¼WATT5%C.F.	
R66	RES.1500HM¼WATT5%C.F.	
R3	RES.15KOHM¼WATT5%C.F.	
R34	RES.16KOHM¼WATT5%C.F.	
R50	RES.2.4KOHM¼WATT1%M.F.	DALE RL0792-2.4K-G
R13,23,36,40, 41	RES.2.4KOHM¼WATT5%C.F.	
R56	RES.20KOHM¼WATT5%C.F.	
R8	RES.220OHM¼WATT5%C.F.	
R6	RES.270HM1WATT5%C.C.	
R7,12,25	RES.2KOHM¼WATT5%C.F.	
R67	RES3.6KOHM¼WATT5%C.F.	
R51,53	RES.3.9KOHM¼WATT5%C.F.	
R29	RES.300KOHM¼WATT5%C.F.	
R61	RES.30KOHM¼WATT1%M.F.	DALE RL0793-03-G
R15-18,26-28, 54,55,64	RES.4.7KOHM¼WATT5%C.F.	
R62	RES.45.3KOHM¼WATT1%M.F.	DALE RN55D4532F
R30,33	RES.470HM¼WATT5%C.F.	
R21	RES.4700HM¼WATT5%C.F.	
R19	RES.47KOHM¼WATT5%C.F.	
R35	RES.5100HM¼WATT5%C.F.	
R43	RES.6.2KOHM¼WATT5%C.F.	
R60	RES.7.5KOHM¼WATT5%C.F.	
R37	RES.75KOHM¼WATT5%C.F.	
R9	RES.76KOHM¼WATT1%M.F.	DALE RN60D7682F
R11	RES.8200HM¼WATT5%C.F.	
U2,11,14,16,22	RES.DIP NETWRK.47KOHM	CT9 761-1R47K
C21,41,45	CAP.AXIAL1MF@25OVDC	MALLORY #TC56
C24	CAP.AXIAL220MF@25OVDC	MALLORY LP22192500TP3
C10	CAP.AXIAL ALUM ELEC. 4700 OMF@35VDC	MALLORY TCG472U035N1C
C1,2,3,55,60	CAP.RADIAL DIPPED TANT. 10MF@25VDC	KEMET T350E106M025AS
C53	CAP.RADIAL DIPPED TANT. 1MF@35VDC	KEMET T350A105K035AS
C36	CAP.RADIAL DIPPED TANT. 47MF@10VDC	KEMET T350B566M010AS

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
C54	CAP.RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J3C1
C57	CAP.RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP.RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
C6	CAP.RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30,35,37	CAP.RADIAL Z5U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4,7	CAP.RADIAL Z5U MLC .01MF@50VDC	KEMET C315C103K5R5CA
C4,5,6,9,11-19, 22,23,25-28 C31-34,37,42,43 47,48,50-52 C56,58,59	CAP.RADIAL Z5U MLC .22MF@50VDC	KEMET C322C224M5U5CA
C46	CAP.VARI.2-12PF.	JOHANSEN #9626
CR7,8,9,10, 11,12,17	DIODE SIL.	ITT.FAIRCHLD.IN4148
CR1,2,3,4	DIODE SIL.FAST	GENL.INST.EGP10D
CR5	DIODE SIL.FASTHIVOLT	GENL.INST.UF4007
CR6,13,15	DIODE SIL.REF.2,500VDC	NATL.SEMI-LM385Z-2.5
CR14,16	DIODE SIL.ZENER3.9V.25WATT	MOTOROLA 1N4623A
U6,13,15,17	SWITCH 8 POSITION DIP	CTS 206-8
Q2,9,12	TRANSTOR.COMMON NPN	MOTOROLA 2N2222A
Q8,10,11	TRANSTOR.COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR.HIVOLTHIFREQ.NPN	MOTOROLA MPSU10
Q7	TRANSTOR.HIVOLTHIFREQ.PNP	MOTOROLA MPSU60
Q1	TRANSTOR.HIVOLTHI.NPN	TI,MOTOROLATIP48
Q3,14	TRANSTOR.HIVOLTNPN2N3439	MOTOROLA 2N3439
Q13	TRANSTOR.HIVOLTPNP	MOTOROLA MJE5731
U5,27	IC 1-SHOT 74HC221	NATL.SEMI MM74HC221N
U23,26	IC 1-SHOT 74LS221	NATL.SEMI DM74LS221N
U7-10	IC COMPARATOR 74HC688	NATL.SEMI MM74HC688N
U30	IC CONVERTER DAC0800	NATL.SEMI DAC0800LCN
U24,25	IC COUNTER 74HC193	NATL.SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JM
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 734
U4	IC OC DRIVER SN7406	NATL.SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. MM74HC374N
U12,29,31,32	IC OP AMP LF256	NATL.SEMI LF256H
U18,19,20,21	IC OPTO ISOLATOR	HEWLTT-PCKRD HCPL2300
R24,42,63	POT100KOHM½WATT10%	BOURNS 3622-1-104
R38,49,52	POT10KOHM½WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM½WATT10%	BOURNS 3622W-1-253
R14,31	POT2KOHM½WATT10%	BOURNS 3622W-1-202

Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
VR1	REGULATOR 5VDC	NATL.LM340T-5.0
R10	RES.1MEGOHM¼WATT5%C.F.	
R2,4	RES.1.2KOHM¼WATT5%C.F.	
R32	RES.1.6KOHM¼WATT5%C.F.	
R44	RES.1.8KOHM¼WATT5%C.F.	
R1	RES.10MEGOHM¼WATT5%C.F.	
R5,R22	RES.100HM¼WATT5%C.F.	
R65	RES.100KOHM¼WATT5%C.F.	
R59	RES.10KOHM¼WATT1%M.F.	DALE RN55D1002F
R100	RES.270OHM	
R101,108	RES.470OHM	
R102,103 106,109,110	RES.1KOHM	
R104	RES.4700OHM	
R105	POT.100KOHM	
R107	POT.10KOHM	
R111,113	RES.220OHM	
R112	RES.220HM	
R114,115	RES. 470HM	
C100	CAP.10MFD35 VDC	
C108	CAP.10000 PF	
D100	DIODE	1N4148
Q100,105	TRANSTOR	2N2222
Q101,102	TRANSTOR	2N3906
Q103,104	TRANSTOR	2N3904
U100,U108	IC 1-SHOT	74LS123
U103,104 105,106	IC INVERTOR	74LS04
U108	IC LINE DECODER	74LS138

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

APPENDIX

```
Offset  Data    Source Line
0030    0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Calibration' $LINESIZE: 132
0030    0006     MODULE  - 'REACAL'
0030    0006    '
0030    0006    'AUTHOR  - M. A. Enevold
0030    0006    '
0030    0006    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006    'REVISION - 2.0 07-01-86 MAE MicroFab modifications
0030    0006    '         - 1.0 02-11-86 MAE Creation of initial code
0030    0006    '
0030    0006    'SYSTEM  - This code can only be compiled by the BASCOM
0030    0006    '          COMPILER, it will not run under the INTERPRETER!!
0030    0006    '
0030    0006    'DESCRIPTION:
0030    0006    '       The reagent calibrate module presents a menu with 12 items arranged
0030    0006    '       in 3 columns of 4 rows.  The arrow keys allow movement around the
0030    0006    '       table, the + and - keys increment or decrement values in the first
0030    0006    '       column, and the enter key executes commands in the third column.
0030    0006    '       The second column is an array of ASCII strings representing reagent name,
0030    0006    '       concentration, density, and viscosity.  The values entered in column one
0030    0006    '       are drop frequency, pulse width, strobe delay, and nozzle number.
0030    0006    '       The commands in the third column are start/stop, load, save, and exit.
0030    0006    '
0030    0006    'DATA DICTIONARY
0030    0006    '       MENU%          Pointer to which menu item is active (0-11)
0030    0006    '       MENU$(17,1)    Array for strings used to display the menu
0030    0006    '       MENU(17,4)     Array for numbers in the menu display
0030    0006    '       DIFF%          Differential to move MENU% at arrow key input
0030    0006    '       TYPE%          Pointer set during main scan to direct action
0030    0006    '       KEYBUF$        Storage for string input from menu display
0030    0006    '       A$             Destination for single keystroke inputs
0030    0006    '       FILE$          String where filename is built for reagent data file
0030    0006    '       REANAME$       String where reagent name is stored
0030    0006    '       R%             Row to display special graphics character in menu
0030    0006    '       C%             Column to display special graphics character in menu
0030    0006    '       M%             Special graphics character is read into here
0030    0006    '       OLD.AMP.VALUE% Integer value for setting pulse amplitude
0030    0006    '       DIG.VAL%       Value set to digital port 0 to inc/dec amplitude
0030    0006    '
0030    0006    SUB REAGENT.CALIBRATE STATIC
0047    0006
0047    0006            DIM MENU$(17,1),MENU(17,4)
0048    01FE
0048    01FE            GOSUB INITIALIZE:       'read init. values and set screen
004E    01FE
004E    01FE            WHILE TYPE% <> 1
0059    0200
0059    0200              TYPE% = 0
0060    0200              A$ = ""
006A    0204
006A    0204              WHILE A$ = ""
0079    0204                A$ = INKEY$
0083    0204                IF ACTIVE% = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
00AD    020A              WEND
00B0    020A
```

Reagent Jet Printer
Reagent Calibration

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line
00B0    020A            IF A$ = CHR$(13) THEN TYPE% = 1:            'execute (cr)
00CA    020A            IF A$ = "+" THEN TYPE% = 2:                 'increment variable
00E0    020A            IF A$ = "-" THEN TYPE% = 3:                 'decrement variable
00F6    020A            IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 4:  'up arrow key
011B    020A            IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 5:  'down arrow key
0140    020A            IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 6:  'left arrow key
0165    020A            IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 7:  'right arrow key
018A    020A            IF A$ > CHR$(47) AND A$ < CHR$(123) THEN TYPE% = 8:' ascii 0 - z
01C2    020A
01C2    020A            ON TYPE% GOSUB T1, T2, T3, T4, T5, T6, T7, T8
01DB    020A
01DB    020A          WEND
01DF    020A          TYPE% = 0
01E6    020A
01E6    020A          EXIT SUB
01EA    020A    REM $PAGE
```

Reagent Jet Printer
Reagent Calibration

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line

01EA    0208    '************ SUBROUTINES FOR THIS MODULE ************
01EA    020A
01EA    020A    T1:             '<cr> execute command
01EF    020A            IF MENU% < 12 THEN TYPE% = 0:RETURN:    'exit to print menu, no action
0205    020C            ON MENU% - 11 GOSUB T1A, T1B, T1C, T1D
021A    020C            IF MENU% < 15 THEN TYPE% = 0
022C    020C            RETURN
0230    020C
0230    020C    T1A:            'start/stop drop flow
0235    020C            IF MENUS(12,0) = "START" THEN GOSUB START.INK
025A    020C            IF MENUS(12,0) = "STOP " THEN GOSUB STOP.INK
027F    020C            MENUS(12,0) = TEMP$
029A    0210            COLOR 0,7:GOSUB DISPMENU
02AC    0210            RETURN
02B0    0210
02B0    0210    START.INK:
02B5    0210            TEMP$ = "STOP "
02BF    0210            CALL DOT.ON:            'in module PCI
02CB    0210            LOCATE 17,71:COLOR 27,0:PRINT "PRINTING";
02F1    0210            ACTIVE% = 1
02F8    0210            RETURN
02FC    0210
02FC    0210    STOP.INK:
0301    0210            TEMP$ = "START"
030B    0210            CALL DOT.OFF:           'in module PCI
0317    0210            LOCATE 17,71:COLOR 15,0:PRINT "       ";
033D    0210            ACTIVE% = 0
0344    0210            RETURN
0348    0210
0348    0210    T1B:            'load reagent profile
034D    0210            IF MENUS(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
0391    0210
0391    0210            GOSUB SEARCH
0397    0210
0397    0210            IF I% < (REANUM% + 1) THEN GOTO FOUND
03AB    0214            LOCATE 25,10-LEN(MENUS(6,1))/2:PRINT MENUS(6,1);" not Found";
0404    0214            GOSUB ANYKEY:   'wait for a keyhit
040A    0214            RETURN
040E    0214
040E    0214    FOUND:
0413    0214            FILE$ = RIGHT$(STR$(I%),LEN(STR$(I%))-1) + "REA.RJP"
0437    0218            OPEN FILE$ FOR INPUT AS #1:     'set pattern data file for read
0448    0218            INPUT #1,MENU(0,0):     'read frequency
0468    0218            INPUT #1,MENU(1,0):     'read amplitude
0488    0218            INPUT #1,MENU(2,0):     'read strobe delay
04AE    0218            INPUT #1,MENU(3,0):     'read pulse width
04D1    0218            INPUT #1,MENU(4,0):     'read rise time
04F4    0218            INPUT #1,MENU(5,0):     'read fall time
0519    0218
0519    0218            INPUT #1,MENUS(7,1):    'read concentration
0538    0218            INPUT #1,MENUS(8,1):    'read density
0561    0218            INPUT #1,MENUS(9,1):    'read viscosity
0585    0218            INPUT #1,MENUS(10,1):   'read surface tension
05A9    0218
```

```
5 Reagent Jet Printer                                                                    PAGE  4
  Reagent Calibration                                                                    07-14-86
                                                                                         12:24:57
  Offset  Data   Source Line                                    IBM Personal Computer BASIC Compiler V2.00

  05A9  0218          CLOSE #1:       'done with data file
10 05B0  0218
  05B0  0218          OPEN "READEF.RJP" FOR OUTPUT AS #1
  05C2  0218          PRINT #1,FILE$:                 'save filename in default file
  05D2  0218          PRINT #1,MENU$(6,1):    'save the directory name as well
  05F4  0218          CLOSE #1
  05FB  0218          GOSUB DISP.PARMS:       'show all parameters
15 0601  0218          RETURN
  0603  0218
  0603  0218    TIC:          'save reagent profile
  060A  0218          IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
  064E  0218          OPEN "READIR.RJP" FOR INPUT AS #1
  065F  0218          INPUT #1,REANUM%
20 0671  0218          CLOSE #1
  0678  0218          IF REANUM% < 80 THEN GOTO SAVE.REA
  0687  0218          LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
  06A1  0218          GOSUB ANYKEY:RETURN
  06AB  0218    SAVE.REA:
  0680  0218          GOSUB SEARCH
25 0686  0218          IF I% > REANUM% THEN GOTO SAVEREA1
  06C7  0218          REANUM% = I%
  06CE  0218          COLOR 15,0
  06DA  0218          LOCATE 25,1:PRINT MENU$(6,1);" already exists. Replace it with new values? ";
  070C  0218          A$ = ""
  0716  0218          WHILE A$ = ""
30 0725  0218                A$ = INKEY$
  072F  0218          WEND
  0732  0218          LOCATE 25,1:PRINT SPACE$(79);
  074F  0218          IF A$ = "Y" OR A$ = "y" THEN GOTO REPLACE
  0778  0218          RETURN
  077C  0218
35 077C  0218    SAVEREA1:
  0781  0218          KILL "READIR.OLD":      'delete old backup directory
  0788  0218          NAME "READIR.RJP" AS "READIR.OLD":      'save old directory
  0792  0218          OPEN "READIR.OLD" FOR INPUT AS #1
  07A3  0218          OPEN "READIR.RJP" FOR OUTPUT AS #2:     'set up new dir
  07B5  0218
40 07B5  0218          INPUT #1,REANUM%:       'read number of dir entries
  07C7  0218          REANUM% = REANUM% + 1:  'increase by 1
  07D0  0218          WRITE #2,REANUM%:       'save in new directory
  07E1  0218
  07E1  0218          FOR I=1 TO REANUM% - 1
45 07FA  021C             LINE INPUT #1,A$:    'read entry from old dir
  0807  021C             PRINT #2,A$:         'write entry in new directory
  0817  021C          NEXT I
  0832  0220
  0832  0220          CLOSE #1
  0839  0220
50 0839  0220          PRINT #2,MENU$(6,1):    'write new entry to new directory
  0858  0220          CLOSE #2:       'done with directory
  0862  0220
  0862  0220    REPLACE:
  0867  0220          FILE$ = RIGHT$(STR$(REANUM%),LEN(STR$(REANUM%))-1) + "REA.RJP"
  088B  0220
55
```

```
Reagent Jet Printer                                                                    PAGE  5
Reagent Calibration                                                                    07-14-86
                                                                                       12:26:57
Offset  Data    Source Line                                    IBM Personal Computer BASIC Compiler V2.00

088B    0220            OPEN FILES FOR OUTPUT AS #1:    'create new pattern data file
089D    0220            WRITE #1,MENU(0,0):     'store frequency
088B    0220            WRITE #1,MENU(1,0):     'store amplitude
08DC    0220            WRITE #1,MENU(2,0):     'store strobe delay
08FD    0220            WRITE #1,MENU(3,0):     'store pulse width
091E    0220            WRITE #1,MENU(4,0):     'store rise time
093F    0220            WRITE #1,MENU(5,0):     'store fall time
0962    0220
0962    0220            WRITE #1,MENUS(7,1):    'store concentration
0984    0220            WRITE #1,MENUS(8,1):    'store density
09A6    0220            WRITE #1,MENUS(9,1):    'store viscosity
09C8    0220            WRITE #1,MENUS(10,1):   'store surface tension
09EA    0220
09EA    0220            CLOSE #1:       'done with data file
09F1    0220
09F1    0220            OPEN "READEF.RIP" FOR OUTPUT AS #1
0A03    0220            PRINT #1,FILE$:                 'save filename in default file
0A13    0220            PRINT #1,MENUS(6,1):    'save the directory name as well
0A35    0220            CLOSE #1
0A3C    0220            RETURN
0A40    0220
0A40    0220    SEARCH:
0A45    0220            OPEN "READIR.RIP" FOR INPUT AS #1
0A56    0220            INPUT #1,READNUM%:      'read number of patterns in dir
0A68    0220            I% = 1:                         'set entry pointer
0A6F    0220
0A6F    0220    SLOOP:
0A74    0220            LINE INPUT #1,A$:       'read next pattern name from dir
0A81    0220            IF A$ = MENUS(6,1) THEN GOTO SEARCH.DONE:       'compare name with dir entry
0AA5    0220            I% = I% + 1
0AAE    0220            IF I% < (READNUM% + 1) THEN GOTO SLOOP:'check for done
0AC1    0220    SEARCH.DONE:
0AC6    0220            CLOSE #1
0ACD    0220            RETURN
0AD1    0220
0AD1    0220    T1D:            'return with no change to exit reagent calibrate
0AD6    0220            PRINT #3,"UM";
0AE6    0220            CLOSE #3:'      close com channel
0AEB    0220            RETURN
0AF1    0220
0AF1    0220    T2:             'process "+" key
0AF6    0220            IF MENUI > 5 THEN RETURN
0B05    0220            NEWTIME = TIMER
0B0F    0224            DELTATIME = NEWTIME - OLDTIME
0B1F    022C            OLDTIME = NEWTIME
0B29    022C            IF DELTATIME > 0.15 THEN MULTI = 1 ELSE MULTI = MULTI + 1
0B40    022E            IF MULTI > 100 THEN MULTI = 100
0B5B    022E            MENU(MENUI,0) = MENU(MENUI,0) + MENU(MENUI,3) * MULTI:  'add increment
0B9F    022E            IF MENU(MENUI,0) > MENU(MENUI,1) THEN MENU(MENUI,0) = MENU(MENUI,1):    'check max value
0C06    022E            COLOR 15,1:GOSUB DISPMENU:RETURN:                       'show new value
0C1D    022E
0C1D    022E    T3:             'process "-" key
0C22    022E            IF MENUI > 5 THEN RETURN
0C31    022E            NEWTIME = TIMER
```

```
Reagent Jet Printer
Reagent Calibration                                                                    PAGE   6
                                                                                       07-14-86
Offset  Data    Source Line                                                            12:26:57
                                                                  IBM Personal Computer BASIC Compiler V2.00

0C3B    022E          DELTATIME = NEWTIME - OLDTIME
0C48    022E          OLDTIME = NEWTIME
0C55    022E          IF DELTATIME > 0.15 THEN MULT% = 1 ELSE MULT% = MULT% + 1
0C77    022E          IF MULT% > 100 THEN MULT% = 100
0C89    022E          MENU(MENUX,0) = MENU(MENUX,0) - MENU(MENUX,3) * MULT%:  'sub increment
0CCB    022E          IF MENU(MENUX,0) < MENU(MENUX,2) THEN MENU(MENUX,0) = MENU(MENUX,2):    'check min value
0D22    022E          COLOR 15,1:GOSUB DISPMENU:RETURN:                        'show new value
0D49    022E
0D49    022E    T4:           'process up arrow key
0D4E    022E          IF MENUX MOD 6 = 0 THEN RETURN:              'in top row already
0D63    022E          DIFF% = -1:GOSUB NEWMENU:RETURN:         'move pointer up one
0D74    0230
0D74    0230    T5:           'process down arrow key
0D79    0230          IF MENUX MOD 6 = 5 THEN RETURN:                'in bottom row already
0D8F    0230          DIFF% = 1:GOSUB NEWMENU:RETURN:                'move pointer down one
0DA0    0230
0DA0    0230    T6:           'process left arrow key
0DA5    0230          IF INT(MENUX / 6) = 0 THEN RETURN        'in left column already
0DC5    0230          DIFF% = -6:GOSUB NEWMENU:RETURN:         'move pointer one left
0DD6    0230
0DD6    0230    T7:           'process right arrow key
0DDB    0230          IF INT(MENUX / 6) = 2 THEN RETURN        'in right column already
0DFE    0230          DIFF% = 6:GOSUB NEWMENU:RETURN:                'move pointer one right
0E0F    0230
0E0F    0230    T8:           'input keys into KEYBUF$ until (cr) is entered
0E14    0230          IF MENUX > 10 THEN RETURN
0E23    0230          LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E35    0230          KEYBUF$ = A$
0E3F    0234          WHILE A$ <> CHR$(13)
0E72    0234                LOCATE 25,47:PRINT SPACE$(15);
0E8F    0234                LOCATE 25,47:PRINT KEYBUF$;
0EA9    0234                A$ = ""
0EB3    0234                WHILE A$ = ""
0EC2    0234                      A$ = INKEY$
0ECC    0234                      IF ACTIVE% = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
0EF6    0234                WEND
0EF9    0234                IF A$ = CHR$(8) AND LEN(KEYBUF$) > 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
0F3B    0234                IF A$ > CHR$(31) AND LEN(KEYBUF$) < 15 THEN KEYBUF$ = KEYBUF$ + A$
0F75    0234          WEND
0F79    0234
0F79    0234          IF MENUX > 5 THEN GOTO STORESTRING
0F88    0234
0F88    0234          TEMP = VAL(KEYBUF$)      'temp has value of keys input
0F98    0238
0F98    0238          'round off temp according to step size in menu array
0F98    0238          TEMP = INT((TEMP / (MENU(MENUX,3)) + .5) * MENU(MENUX,3)
0FD1    0238
0FD1    0238          'test TEMP for maximum and minimum values in menu array
0FD1    0238          IF TEMP > MENU(MENUX,1) THEN TEMP = MENU(MENUX,1)
1019    0238          IF TEMP < MENU(MENUX,2) THEN TEMP = MENU(MENUX,2)
104F    0238
104F    0238          'insert new value into menu array and update screen
104F    0238          MENU(MENUX,0) = TEMP
1068    0238          LOCATE 25,30:PRINT SPACE$(40);
```

```
Reagent Jet Printer                                                                    PAGE  7
Reagent Calibration                                                                    07-14-86
                                                                                       12:26:57
Offset  Data   Source Line                                        IBM Personal Computer BASIC Compiler V2.00

1088    0238           COLOR 0,7:GOSUB DISPMENU
109A    0238           RETURN
109E    0238
109E    0238   STORESTRING:
10A3    0238           MENU$(MENUI,1) = KEYBUF$
10BF    0238           LOCATE 25,30:PRINT SPACE$(40);
10DC    0238           COLOR 0,7:GOSUB DISPMENU
10EE    0238           RETURN
10F2    0238
10F2    0238   PEN.DOWN:
10F7    0238           DOWNTIME = TIMER + 1
1107    0238           PRINT #3,"D";
1117    0238           RETURN
111B    0238
111B    0238   ANYKEY:
1120    0238           LOCATE 25,64:PRINT "Strike any key..";
113A    0238           A$ = ""
1144    0238           WHILE A$ = ""
1153    0238                  A$ = INKEY$
115D    0238           WEND
1160    0238           LOCATE 25,1:COLOR 15,0:PRINT SPACE$(79);:COLOR 15,1
1196    0238           RETURN
119A    0238
119A    0238   NEWMENU: 'write old item in yellow. point to and highlight new item
119F    0238           COLOR 14,0:GOSUB DISPMENU
11B1    0238           MENUI = MENUI + DIFFI
11BD    0238           IF MENUI < 11 THEN MENUI = 10
11CF    0238           IF MENUI > 15 THEN MENUI = 15
11E1    0238           COLOR 0,7:GOSUB DISPMENU:RETURN
11F7    0238
11F7    0238   INITIALIZE:
11FC    0238           'change to second screen and display messages
11FC    0238           SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
1240    0238           LOCATE 12,33:PRINT "Please wait..."
125A    0238
125A    0238           'Initialize variables
125A    0238
125A    0238           ACTIVE2 = 0:'   not printing
1261    0238
1261    0238           'initialize plotter com channel
1261    0238
1261    0238           OPEN "COM1:2400,N,8,2" AS #3
1273    0238           PRINT #3,";:UEC3,EFV1,H";
1283    0238
1283    0238           'initialize digital port
1283    0238           SCR% = 4
128A    023A           CALL DIGITAL.OUT(SCR%)
129A    023A           SCR% = 0
12A1    023A           CALL DIGITAL.OUT(SCR%):         'pulse reset line to set amplitude to 0V.
12B1    023A           SCR% = 4
12B8    023A           CALL DIGITAL.OUT(SCR%)
12C8    023A
12C8    023A           'set hardware pulse width
12C8    023A           CALL SET.DOT.WIDTH(5)    'in module PCI
```

```
Reagent Jet Printer                                                                    PAGE  8
Reagent Calibration                                                                    07-14-86
                                                                                       12:26:57
 Offset- Data    Source Line                                   IBM Personal Computer BASIC Compiler V2.00

 120E   023C
 120E   023C          'initialize menu arrays
 120E   023C          RESTORE ARRDATA
 12E3   023C          FOR IX=0 TO 17
 12E3   023C                READ MENUS(IX,0),MENUS(IX,1):
 12E3   023C                READ MENU(IX,1),MENU(IX,2),MENU(IX,3),MENU(IX,4)
 1318   023C          NEXT IX
 137C   023C
 138F   023C          'set default reagent values
 138F   023C
 138F   023C          MENU(0,0) = 2000:              'frequency
 13A8   023C          MENU(1,0) = 0:                 'amplitude
 13C4   023C          MENU(2,0) = 1:                 'strobe delay
 13E0   023C          MENU(3,0) = 090:               'pulse width
 13FC   023C          MENU(4,0) = 470:               'rise time
 1418   023C          MENU(5,0) = 070:               'fall time
 1436   023C
 1436   023C          MENU(6,0) = 0:                 'mass
 1452   023C          MENU(7,0) = 0:                 'concentration
 146E   023C          MENU(8,0) = 0:                 'density
 148A   023C          MENU(9,0) = 0:                 'viscosity
 14A6   023C          MENU(10,0) = 0:                      'surface tension
 14C2   023C
 14C2   023C          OLD.AMP.VALUE% = 0             'initial value of 0 volts
 14C9   023E
 14C9   023E          'change active displayed screen to first screen to draw and display parameters
 14C9   023E
 14C9   023E          SCREEN 0,0,0,1:CLS
 14E6   023E
 14E6   023E          COLOR 15:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
 1507   023E          COLOR 9
 150E   023E          FOR I=2 TO 79
 1518   023E                LOCATE 3,I:PRINT "9";:LOCATE 5,I:PRINT "8";:LOCATE 19,I:PRINT "8";
 156F   023E          NEXT I
 158A   023E          FOR I=4 TO 18
 1594   023E                LOCATE I,1:PRINT "I";:LOCATE I,28:PRINT ":";:LOCATE I,69:PRINT ":";:LOCATE I,80:PRINT "I";
 1608   023E          NEXT I
 1626   023E          RESTORE TABLE
 1628   023E          FOR I=1 TO 12
 1637   023E                READ R%,C%,N%:LOCATE R%,C%:PRINT CHR$(N%);
 166A   0244          NEXT I
 1685   0244
 1685   0244          'print three headings and instructions
 1685   0244          COLOR 10,0
 1691   0244          LOCATE 4,7:PRINT "DROP PARAMETERS";
 16AB   0244          LOCATE 4,39:PRINT "REAGENT PARAMETERS"
 16C5   0244          LOCATE 4,71:PRINT "COMMANDS";
 16DF   0244
 163F   0244          COLOR 7:LOCATE 21,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
 1729   0244          PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
 1768   0244          LOCATE 22,19:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
 178E   0244          COLOR 7:PRINT" to scroll current value up or down";
 17D2   0244          LOCATE 23,26:PRINT "Use ";:COLOR 15:PRINT "ENT";:COLOR 7:PRINT" to activate selection";
 1814   0244
```

```
Reagent Jet Printer                                                    PAGE  9
Reagent Calibration                                                    07-14-86
                                                                       12:26:57
                                                  IBM Personal Computer BASIC Compiler V2.00

 Offset  Data    Source Line
1814   0244    DISP.PARMS:
1819   0244            'display 12 menu choices in yellow
1819   0244
1819   0244            COLOR 14,0
1825   0244            FOR MENUZ = 0 TO 17
1828   0244                    GOSUB DISPMENU
1831   0244            NEXT MENUZ
1841   0244
1841   0244            'set for reagent name and highlight it
1841   0244            MENUZ = 6:COLOR 0,7
1854   0244            GOSUB DISPMENU
185A   0244
185A   0244            SCREEN 0,0,0,0
186F   0244            RETURN
1873   0244    REM $PAGE
```

```
Reagent Jet Printer
Reagent Calibration                                                                    PAGE 10
                                                                                       07-14-86
Offset  Data   Source Line                                                            12:26:57
                                                          IBM Personal Computer BASIC Compiler V2.00

 1873   0244   DISPMENU:
 1878   0244          LOCATE (MENUI MOD 6)*2+7,(INT(MENUI/6)*28+2)+15*INT(MENUI/12)
 18D4   0244          PRINT MENUS(MENUI,0)
 18F2   0244          IF MENUI > 5 THEN GOTO SHOWSTRING:'     no value to display
 1901   0244          LOCATE (MENUI MOD 6)*2+7,MENU(MENUI,4)
 1933   0244          PRINT USING MENUS(MENUI,1);MENU(MENUI,0);
 1966   0244          IF MENUI > 2 THEN RETURN
 1975   0244          ON MENUI+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
 1986   0244          RETURN
 198A   0244   SHOWSTRING:
 198F   0244          IF MENUI > 10 THEN RETURN
 19FE   0244          LOCATE (MENUI MOD 6)*2+7,48
 19BA   0244          PRINT "                "
 19C7   0244          LOCATE (MENUI MOD 6)*2+7,48
 19E3   0244          PRINT MENUS(MENUI,1)
 1A02   0244          RETURN
 1A06   0244
 1A06   0244   SET.FREQ:
 1A08   0244          TEMP = MENU(0,0)
 1A24   0244          CALL SET.DOT.RATE(TEMP):        'in module PCI
 1A34   0244          LEDI = 3-INT((TEMP+500)/1000)
 1A57   0246          IF LEDI < 0 THEN LEDI = 0
 1A69   0246          SCRI = 4 + (LEDI * 32):                'set LED intensity
 1A89   0246          CALL DIGITAL.OUT(SCRI):                'in module PCI
 1A99   0246          RETURN
 1A9D   0246
 1A9D   0246   SET.AMP:
 1AA2   0246          SCRI = CINT(MENU(MENUI,3) * 255 / 150):        'convert volts to binary number
 1AC8   0246          IF SCRI = OLD.AMP.VALUEI THEN RETURN
 1ADC   0246          TEMPI = SCRI - OLD.AMP.VALUEI:         'calculate delta
 1AE8   0248          OLD.AMP.VALUEI = SCRI:                 'update old value to current value
 1AEF   0248          DIG.VALI = 6
 1AF6   024A          IF TEMPI < 0 THEN DIG.VALI = 5
 1B08   024A          TEMPI = ABS(TEMPI)
 1B15   024A          FOR II = 1 TO TEMPI
 1B22   024C                SCRI = DIG.VALI + (32*LEDI)
 1B3F   024C                CALL DIGITAL.OUT(SCRI):          'pulse higher or lower
 1B4F   024C                SCRI = 4 + (32 * LEDI)
 1B6F   024C                CALL DIGITAL.OUT(SCRI):          'set port to normal
 1B7F   024C          NEXT II
 1B91   024C          RETURN
 1B95   024C
 1B95   024C   SET.DELAY:
 1B9A   024C          TEMP = MENU(2,0)
 1BB6   024C          CALL SET.STROBE.DELAY(TEMP):    'in module PCI
 1BC6   024C          RETURN
 1BCA   024C
 1BCA   024C   REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  11
Reagent Calibration                                                    07-14-86
                                                                       12:26:57
                                                  IBM Personal Computer BASIC Compiler V2.00

 Offset  Data   Source Line

  1BCA   024C   '************ DATA USED BY THIS MODULE ************
  1BCA   024C
  1BCA   024C   ARRDATA:
  1BCF   024C           DATA "Frequency              Hz",",##,###",10000,1,1,16
  1BD1   024C           DATA "Amplitude              V ",",###",150,0,1,19
  1BD3   024C           DATA "Strobe Delay           uS",",##,###.#",15999.5,.5,.5,16
  1BD5   024C           DATA "Pulse Width              ",",###",999,0,1,19
  1BD7   024C           DATA "Rise Time                ",",###",999,0,1,19
  1BD9   024C           DATA "Fall Time                ",",###",999,0,1,19
  1BDB   024C           DATA "Name","",0,0,0,0
  1BDD   024C           DATA "Concentration","",0,0,0,0
  1BDF   024C           DATA "Density","",0,0,0,0
  1BE1   024C           DATA "Viscosity","",0,0,0,0
  1BE3   024C           DATA "Surface Tension","",0,0,0,0
  1BE5   024C           DATA "","",0,0,0,0
  1BE7   024C           DATA "START","",0,0,0,0
  1BE9   024C           DATA "LOAD","",0,0,0,0
  1BEB   024C           DATA "SAVE","",0,0,0,0
  1BED   024C           DATA "EXIT","",0,0,0,0
  1BEF   024C           DATA "","",0,0,0,0
  1BF1   024C           DATA "","",0,0,0,0
  1BF3   024C
  1BF3   024C   TABLE:
  1BF8   024C           DATA 3,1,218
  1BFA   024C           DATA 3,28,210
  1BFC   024C           DATA 3,69,210
  1BFE   024C           DATA 3,80,191
  1C00   024C           DATA 5,1,198
  1C02   024C           DATA 5,28,206
  1C04   024C           DATA 5,69,206
  1C06   024C           DATA 5,80,181
  1C08   024C           DATA 19,1,192
  1C0A   024C           DATA 19,28,208
  1C0C   024C           DATA 19,69,208
  1C0E   024C           DATA 19,80,217
  1C10   024C
  1C10   024C   END SUB
  1C17   024C
  1C17   024C
  2EEB-  024C

 50426 Bytes Available
 43960 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

```
Offset  Data   Source Line                    IBM Personal Computer BASIC Compiler V2.00

0030    0006   REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Pattern Entry/Modif
               ication'
0030    0006   'MODULE   - "PATENT" Pattern creation, modification, and filing
               .
0030    0006   .
0030    0006   'AUTHOR   - N. A. Enevold
0030    0006   .
0030    0006   'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006   .
0030    0006   'REVISION - 1.2 03-10-86 NAE Remove Mouse inputs
0030    0006   .           1.1 02-20-86 NAE Add 80 pattern limit to save
0030    0006   .           1.0 01-13-86 NAE Creation of initial code
0030    0006   .
0030    0006   'SYSTEM   - This code can only be compiled by the BASCOM
0030    0006   .           COMPILER, it will not run under the INTERPRETER!!
0030    0006   .
0030    0006   'DESCRIPTION:
0030    0006   .       This module allows the user to LOAD, SAVE, DIRectory, D
               RAW and
0030    0006   .       enter repeat count and other parameters for a pattern t
               o be printed.
0030    0006   .       The low-resolution graphics mode is selected and a menu
               is displayed
0030    0006   .       across the bottom of the screen.  Using arrow keys
0030    0006   .       point to the action to be taken and then invoke that ac
               tion with the
0030    0006   .       Enter key.  In the DRAW mode, another menu is
0030    0006   .       displayed which allows the user to select from LINE, RE
               CTangle,
0030    0006   .       Solid RECTangle, or CIRCle pattern elements.
0030    0006   .
0030    0006   'DATA DICTIONARY
0030    0006   .       SCNDAT%(50,5)     51 Row (Elements) by 6 Column array f
               or storing pattern elements
0030    0006   .       CURSOR%(9)        Storage for cursor graphics icon
0030    0006   .       MENU$(6)          Up to 7 menu names can be saved here
0030    0006   .       ELNUM%            Count of number of elements in a patt
               ern
0030    0006   .       X% Y%             Current location of graphics cursor
0030    0006   .       GRID              Value of one dot space on the screen
               (default is 0.005")
0030    0006   .       ROW% COL%         Location to print instructions
0030    0006   .       A$                Storage for single key-strokes or inp
               ut strings
0030    0006   .       MENUNUM           Which menu is being displayed (1 or 2
               )
0030    0006   .       ITEM              Pointer to which menu item is highlig
               hted (0 - 6)
0030    0006   .       REPEAT%           Number of times pattern is to be repe
               ated when printed
0030    0006   .       XOFF  YOFF        X and Y axis distance between the pri
               nting of repeated patterns
0030    0006   .       ROWSP COLSP       Row and Column spacing for printing m
               ultiple sets of patterns
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0030    0006    '       PATNUM%                 Number of patterns stored in
the pattern directory PATDIR.RJP
0030    0006    '       DROW% DCOL%     Row and Column location to display di
rectory entrys
0030    0006    '       NAME$           Pattern name to be LOADed or SAVEd to
 directory
0030    0006    '       I% J%           Counters used to LOAD or SAVE the ele
ment data from/to pattern data file
0030    0006    '       FILE$           Name of pattern data file
0030    0006    '       TEMP%           Which type of element is being drawn.
  1 = Line  2 = Rectangle
0030    0006    '
 3 = Solid Rectangle  4 = Circle
0030    0006    '       FLAG%           Same as TEMP% above
0030    0006    '       STARTMSG$ ENDMSG$ Message display for startpoint and en
dpoint of element entry
0030    0006    '       I1% Y1%                 Starting cursor position for
element being drawn
0030    0006    '       DI% DY%                 Delta I and Y values used to
re-position cursor after arrow key
0030    0006    '       MAXITEM                 The highest number item in th
e current menu display
0030    0006    '       I5  IE          Starting and ending I position of the
 menu highlighting blue box
0030    0006    '       RADIUS%                 The calculated radius of a ci
rcle to be displayed
0030    0006    REM $PAGE
```

```
Reagent Jet Printer
Pattern Entry/Modification                                          PAGE  3
                                                                    07-05-86
                                                                    10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006    SUB PATENTRY STATIC
 0047   0006
 0047   0006            WIDTH 40:SCREEN 1:CLS
 005F   0006            DIM SCNDATZ(50,5),CURSORZ(9),MENU$(6)
 0060   029A            ELNUMZ = 0:XZ=0:YZ=0:GRID = 0.005
 007F   02A4
 007F   02A4            LINE (0,0)-(6,6),,B
 00A1   02A4            LINE (0,3)-(6,3),,B
 00C5   02A4            LINE (3,0)-(3,6),,B
 00E9   02A4            PRESET (3,3)
 00F5   02A4            GET (0,0)-(6,6),CURSORZ
 0116   02A4            CLS
 011D   02A4
 011D   02A4            LINE (0,0)-(319,190),,B
 013C   02A4
 0140   02A4            RESTORE INSTRUC
 0147   02A4            FOR I=1 TO 4
 0151   02A4                    READ ROWZ,COLZ,A$
 0164   02AC                    LOCATE ROWZ,COLZ:PRINT A$;
 01B0   02AC            NEXT I
 019B   02B0
 019B   02B0    FIRST:
 01A0   02B0            MENUNUM = 1
 01AA   02B4            GOSUB SUBMENU
 01B0   02B4
 01B0   02B4            ON ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP
                EAT, PATEXT
 01CD   02B8            GOTO FIRST
 01D0   02B8
 01D0   02B8    REPEAT:
 01D5   02B8            GOSUB ITEMBOXERASE:     'erase blue box around DIR
 01DB   02B8            LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 01FB   02B8            LOCATE 25,1:INPUT;"Enter Repeat Count  ",REPEATZ
 0218   02BA            LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 0235   02BA            LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF
 0255   02BE            LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 0272   02BE            LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF
 0292   02C2            GOTO FIRST
 0296   02C2    PATEXT:
 029B   02C2            WIDTH 80:SCREEN 0:CLS
 02B2   02C2            EXIT SUB
 02B6   02C2    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  4
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 02B6   02C2    PATDIR:                    'list directory of patterns
 02BB   02C2            GOSUB ITEMBOXERASE:      'erase blue box around DIR
 02C1   02C2            LOCATE 25,1:PRINT SPACE$(39);   'erase menu line
 02DE   02C2            OPEN "PATDIR.RJP" FOR INPUT AS #1:       'open directory
                 file
 02EF   02C2            INPUT #1, PATNUM%:       'read number of patterns in dir
                ectory
 0301   02C4            LINE (1,1)-(318,189),0,BF:       'erase graphics tablet
 0326   02C4            I = 0:                           'set counter
 0330   02C4
 0330   02C4    DISLOOP:
 0335   02C4            I = I + 1:                'set for next value
 0344   02C4            IF I > PATNUM% THEN GOTO DIREXIT:       'test for done
 035B   02C4            IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
 0384   02C4            IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
 03A9   02C4
 03A9   02C4            LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)
                ";
 03C3   02C4            GOSUB CORLOOP:  'wait for Y or N response
 03C9   02C4            IF A$ = "N" THEN GOTO DIREXIT:  'if N then don't contin
                ue
 03DC   02C4
 03DC   02C4            LINE (1,1)-(318,189),0,BF:       'erase graphics tablet
 0401   02C4
 0401   02C4    SHOWNEXT:
 0406   02C4            DROW% = ((I - 1) MOD 22) + 2:   'calculate row for disp
                lay
 0422   02C6            DCOL% = 4:                       'set coluan to 4
 0429   02C8            IF ((I - 1) MOD 44) > 21 THEN DCOL% = 23:'reset coluan
                if necessary
 044C   02C8
 044C   02C8            LINE INPUT #1, A$:       'read next name from directory
 0459   02C8            LOCATE DROW%,DCOL%:PRINT A$;     'PRINT NAME
 0475   02C8            GOTO DISLOOP
 0479   02C8
 0479   02C8    DIREXIT:
 047E   02C8            CLOSE #1:       'terminate access to PATDIR.RJP
 0485   02C8            GOTO FIRST
 0489   02C8
 0489   02C8    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  5
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data    Source Line        IBM Personal Computer BASIC Compiler V2.00

 0489   02C3    PATLOAD:
 048E   02C3            GOSUB ITEMBOXERASE:     'erase blue box around DIR
 0494   02C3            OPEN "PATDIR.RJP" FOR INPUT AS #1
 04A5   02C3            INPUT #1,PATNUMI:       'read number of patterns in dir
 0487   02C9            GOSUB GETNAME:          'prompt for and input pattern n
                    ame
 04BB   02C3            LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 04E2   02C8
 04E2   02C8            GOSUB SEARCH
 04EB   02C8
 04EB   02C8            IF I% < (PATNUMI + 1) THEN GOTO FOUND
 04FC   02CA            LOCATE 10,16-(LEN(NAME$)/2):PRINT NAME$;" not Found";
 0531   02CE            LOCATE 12,14:PRINT "Strike Any Key"
 054B   02CE            GOSUB ANYKEY:   'wait for a keyhit
 0551   02CE            GOTO FIRST
 0555   02CE
 0555   02CE    FOUND:
 055A   02CE            FILE$ = RIGHT$(STR$(I%),LEN(STR$(I%))-1) + "PAT.RJP"
 057E   02D2            OPEN FILE$ FOR INPUT AS #1:     'set pattern data file
                    for read
 058F   02D2            INPUT #1,ELNUMI:        'read number of elements in pat
                    tern
 05A1   02D2            INPUT #1,GRID:          'read grid size
 05B3   02D2            INPUT #1,REPEATI:       'read repeat count
 05C5   02D2            INPUT #1,IOFF:          'read x axis offset for repeat
 05D7   02D2            INPUT #1,YOFF:          'read y axis offset for repeat
 05E9   02D2
 05E9   02D2            FOR I% = 0 TO ELNUMI - 1
 05F7   02D4                FOR J% = 0 TO 5
 05FD   02D4                    INPUT #1,SCRARRAY(I%,J%):'read file into screen
                    array
 0621   02D6                NEXT J%
 0631   02D6            NEXT I%
 0643   02D6            CLOSE #1:       'done with data file
 064A   02D6
 064A   02D6            OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 065C   02D6            PRINT #1,FILE$:                 'save filename in defau
                    lt file
 066C   02D6            PRINT #1,NAME$:                 'save the directory nam
                    e as well
 067C   02D6            CLOSE #1
 0683   02D6
 0683   02D6            GOTO REDRAW
 0687   02D6
 0687   02D6    SEARCH:
 068C   02D6            I% = 1:                         'set entry pointer
 0693   02D6    SLOOP:
 0698   02D6            LINE INPUT #1,A$:       'read next pattern name from di
                    r
 06A5   02D6            IF A$ = NAME$ THEN GOTO SEARCH.END:     'compare name w
                    ith dir entry
 06B8   02D6            I% = I% + 1
 06C1   02D6            IF I% < (PATNUMI + 1) THEN GOTO SLOOP:'check for done
 06D4   02D6    SEARCH.END:
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0609   0224            CLOSE #1:       'not found so close file and display me
                       ssage
 06E0   0226            RETURN
 06E4   0226
 06E4   0226    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  7
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 06E4   02D6   PATSAVE:
 06E9   02D6           GOSUB ITEMBOXERASE:     'erase blue box around DIR
 06EF   02D6           IF ELNUMI = 0 THEN GOTO FIRST:  'no elements in pattern
 06FE   02D6           OPEN "PATDIR.RJP" FOR INPUT AS #1
 070F   02D6           INPUT #1,PATNUMI
 0721   02D6           IF PATNUMI < 80 THEN GOTO SAVE.PAT:     'directory full
 at 80 patterns
 0730   02D6           CLOSE #1
 0737   02D6           LOCATE 25,1:PRINT SPACE$(39);:          'erase bottom l
 ine
 0754   02D6           LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
 ;
 076E   02D6           GOSUB ANYKEY:GOTO FIRST
 0778   02D6   SAVE.PAT:
 077D   02D6           GOSUB GETNAME:  'prompt for and get pattern name
 0783   02D6           GOSUB SEARCH
 0789   02D6           IF II > PATNUMI THEN GOTO ADD.NEW.PATTERN
 079A   02D6           LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
 07BF   02D6           LOCATE 10,13-(LEN(NAME$)/2):PRINT NAME$;" already exist
 s.";
 07F4   02D6           LOCATE 12,15:PRINT "Replace it?"
 080E   02D6           PATNUMI = II
 0815   02D6           A$ = ""
 081F   02D6           WHILE A$ = ""
 082E   02D6                 A$ = INKEY$
 0838   02D6           WEND
 083B   02D6           IF A$ = "Y" OR A$ = "y" THEN GOTO SAVE.PATTERN
 0864   02D6           GOTO FIRST
 0868   02D6
 0868   02D6   ADD.NEW.PATTERN:
 0860   02D6           KILL "PATDIR.OLD":      'delete old backup directory
 0874   02D6           NAME "PATDIR.RJP" AS "PATDIR.OLD":      'save old direc
 tory
 087E   02D6           OPEN "PATDIR.OLD" FOR INPUT AS #1
 088F   02D6           OPEN "PATDIR.RJP" FOR OUTPUT AS #2:     'set up new dir
 08A1   02D6           INPUT #1,PATNUMI:       'read number of dir entries
 08B3   02D6           PATNUMI = PATNUMI + 1:  'increase by 1
 08BC   02D6           WRITE #2,PATNUMI:       'save in new directory
 08CD   02D6           FOR I=1 TO PATNUMI - 1
 08E6   02DA               LINE INPUT #1,A$:   'read entry from old dir
 08F3   02DA               PRINT #2,A$:        'write entry in new directory
 0903   02DA           NEXT I
 091E   02DA           PRINT #2,NAME$:         'write new entry to new directo
 ry
 092E   02DA           CLOSE #1:CLOSE #2:      'done with directory
 093C   02DA   SAVE.PATTERN:
 0941   02DA           FILE$ = RIGHT$(STR$(PATNUMI),LEN(STR$(PATNUMI))-1) + ".P
 AT.RJP"
 0965   02DA           OPEN FILE$ FOR OUTPUT AS #1:    'create new pattern dat
 a file
 0977   02DA           WRITE #1,ELNUMI:        'store number of elements
 0988   02DA           WRITE #1,GRID:          'store grid dimension
 0998   02DA           WRITE #1,REPEAT%:       'store repeat count
 09A9   02DA           WRITE #1,XOFF:          'store x axis offset for repeat
```

```
Reagent Jet Printer                                                    PAGE  8
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 09E9   02DA            WRITE #1,YOFF:          'store y axis offset for repeat
 09C9   02DA            FOR IZ = 0 TO ELMNMZ - 1
 0907   02DC                FOR JZ = 0 TO 5
 09DD   02EC                    WRITE #1,SCNDATZ(IZ,JZ):        'write screen a
                    rray to file
 0A00   02DC                NEXT JZ
 0A10   02EC            NEXT IZ
 0A22   02DC            CLOSE #1:       'done with data file
 0A29   02DC            OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 0A3B   02DC            PRINT #1,FILE$:                 'save filename in defau
                    lt file
 0A4B   02DC            PRINT #1,NAME$:                 'save the directory nam
                    e as well
 0A5B   02DC            CLOSE #1
 0A62   02DC            GOTO FIRST
 0A66   02DC    REM $PAGE
```

```
Reagent Jet Printer
Pattern Entry/Modification                                          PAGE   9
                                                                    07-05-86
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00  10:46:13

0Ace    02DC    PATPRAM:
0AE3    02DC            GOSUB ITEMBOIERASE
0A71    02DC            LINE (1,1)-(318,189),0,BF:      'Erase graphics tablet
0A96    02DC
0A96    02DC    NEITEL:
0A9B    02DC            MENUNUM = 2
0AA5    02DC            GOSUB SUBMENU
0AAB    02DC
0AAB    02DC            ON ITEM + 1 GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B
                ACKUP
0AC8    02DC            GOTO NEITEL
0ACB    02DC
0ACB    02DC    BACKUP:
0AD0    02DC            GOSUB ITEMBOIERASE
0ADe    02DC            GOTO FIRST
0ADA    02DC
0ADA    02DC    ALINE:
0ADF    02DC            TEMPI = 1
0AE6    02DE            STARTMSG$ = "STARTING ENDPOINT"
0AF0    02E2            ENDMSG$ = "ENDING ENDPOINT  "
0AFA    02E6            GOTO ENTERELEMENT
0AFE    02E6
0AFE    02E6    RECT:
0B03    02E6            TEMPI = 2
0B0A    02E6            GOTO RECTMSG
0B0E    02E6
0B0E    02E6    SRECT:
0B13    02E6            TEMPI = 3
0B1A    02E6    RECTMSG:
0B1F    02E6            STARTMSG$ = "STARTING CORNER"
0B29    02E6            ENDMSG$ = "ENDING CORNER  "
0B33    02E6            GOTO ENTERELEMENT
0B37    02E6
0B37    02E6    ACIRCLE:
0B3C    02E6            TEMPI = 4
0B43    02E6            STARTMSG$ = "CENTER OF CIRCLE"
0B4D    02E6            ENDMSG$ = "POINT ON CIRCLE "
0B57    02E6
0B57    02E6    ENTERELEMENT:
0B5C    02E6            GOSUB ITEMBOIERASE
0B62    02E6            FLAG%=0
0B69    02EB            LOCATE 25,1:PRINT SPACE$(39);
0B86    02EB            LOCATE 25,1:PRINT STARTMSG$;
0BA0    02EB            GOSUB DISPCURSOR
0BA6    02EB    FINDSTART:
0BAB    02EB            GOSUB MOUSEACT
0BB1    02EB            IF A$ = CHR$(27) THEN GOTO ABORT
0BC3    02EB            IF A$ = CHR$(13) THEN GOTO SETSTART
0BCF    02EB            GOSUB CURSORMOVE
0BE5    02EB            GOTO FINDSTART
0BE2    02EB    ABORT:
0BED    02EB            GOSUB PLACECURSOR
0BF3    02EB            GOTO NEITEL
0BF7    02EB
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
 0BF7  02E8   GETSTART:
 0BFC  02E8           LOCATE 25,1:PRINT ENDMSG$;
 0C16  02E8           FLAG% = TEMP%:II% = X%:YI% = Y%
 0C2B  02EC           IF FLAG% = 4 THEN PSET (II%+4,YI%+4)
 0C55  02EC   FINDEND:
 0C5A  02EC           GOSUB MOUSEACT
 0C60  02EC           IF A$ = CHR$(27) THEN GOTO CANCELEL
 0C77  02EC           IF A$ = CHR$(13) THEN GOTO SAVEEL
 0C8E  02EC           GOSUB CURSORMOVE
 0C94  02EC           GOTO FINDEND
 0C97  02EC   CANCELEL:
 0C9C  02EC           GOSUB PLACECURSOR
 0CA2  02EC           ON FLAG% GOSUB ER1, ER2, ER3, ER4
 0CB3  02EC           FLAG% = 0
 0CBA  02EC           GOTO NEXTEL
 0CBE  02EC   SAVEEL:
 0CC3  02EC           GOSUB PLACECURSOR
 0CC9  02EC           IF FLAG% = 4 THEN CIRCLE (XI%+4,YI%+4),SQR((X%-XI%)^2+(
                      Y%-YI%)^2),,,,1
 0D32  02EC           GOSUB CORRECT
 0D3B  02EC           IF A$="N" THEN GOTO REDRAW
 0D4B  02EC   STOREEL:
 0D50  02EC           SCNDAT%(ELNUM%,0) = FLAG%
 0D6A  02EC           SCNDAT%(ELNUM%,1) = II%
 0D85  02EC           SCNDAT%(ELNUM%,2) = YI%
 0DA0  02EC           SCNDAT%(ELNUM%,3) = I%
 0DBB  02EC           SCNDAT%(ELNUM%,4) = Y%
 0DD6  02EC           SCNDAT%(ELNUM%,5) = 0
 0DEF  02EC           ELNUM% = ELNUM% + 1
 0DF8  02EC           FLAG% = 0
 0DFF  02EC           GOTO NEXTEL
 0E03  02EC    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  11
Pattern Entry/Modification                                             07-05-85
                                                                       10:46:17
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler v2.00

 0E03   02EC    REDRAW:
 0E08   02EC            GOSUB ITEMBOXERASE
 0E0E   02EC            LINE(1,1)-(318,189),0,BF
 0E33   02EC            IF ELNUM% = 0 THEN GOTO NEXTEL
 0E42   02EC
 0E42   02EC            FOR I=0 TO ELNUM%-1
 0E5B   02F0                    ON SCNDATX(I,0) GOSUB RD1, RD2, RD3, RD4
 0E81   02F0            NEXT I
 0E9C   02F0            GOTO NEXTEL
 0EA0   02F0
 0EA0   02F0    '******** Sub-routines called by main module ********
 0EA0   02F0
 0EA0   02F0    SUBMENU:
 0EA5   02F0
 0EA5   02F0            LOC      ,1:PRINT SPACE$(39);
 0EC2   02F0            ON       GOSUB MENU1, MENU2
 0ED1   02F0
 0ED1   02F0            FOR I=     6
 0EDB   02F0                    READ MENU$(I)
 0EF2   02F0                    LOCATE 25,(I+6)+2:PRINT MENU$(I);
 0F2B   02F0            NEXT I
 0F46   02F0
 0F46   02F0            READ MAXITEM
 0F4D   02F4            ITEM = 0
 0F57   02F4
 0F57   02F4    NEWITEM:
 0F5C   02F4            GOSUB NEWITEMBOX
 0F62   02F4
 0F62   02F4    NEXTITEM:
 0F67   02F4            GOSUB ITEMSEARCH
 0F6D   02F4            IF A$ = CHR$(13) THEN RETURN:  ITEM has correct value
 0F84   02F4            IF LEN(A$) < 2 THEN BEEP:GOTO NEXTITEM
 0F9A   02F4            IF ASC(MID$(A$,2,1)) = 75 THEN GOTO LEFTAR
 0F96   02F4            IF ASC(MID$(A$,2,1)) = 77 THEN GOTO RIGHTAR
 0FD2   02F4            BEEP:GOTO NEXTITEM
 0FD9   02F4
 0FD9   02F4    LEFTAR:
 0FDE   02F4            IF ITEM = 0 THEN GOTO NEXTITEM
 0FEE   02F4            GOSUB ITEMBOXERASE
 0FF4   02F4            ITEM = ITEM - 1
 1003   02F4            GOTO NEWITEM
 1007   02F4
 1007   02F4    RIGHTAR:
 100C   02F4            IF ITEM = MAXITEM THEN GOTO NEXTITEM
 101F   02F4            GOSUB ITEMBOXERASE
 1025   02F4            ITEM = ITEM + 1
 1034   02F4            GOTO NEWITEM
 1038   02F4
 1038   02F4    MENU1:
 103D   02F4            RESTORE MN1
 1044   02F4            RETURN
 1048   02F4
 1048   02F4    MENU2:
 104D   02F4            RESTORE MN2
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

1054    02F4            RETURN
1058    02F4
1059    02F4    ITEMSEARCH:
105D    02F4            A$ = INKEY$:IF A$ <> "" THEN RETURN
107A    02F4            GOTO ITEMSEARCH
107D    02F4            RETURN
1081    02F4
1081    02F4    NEWITEMBOX:
1086    02F4            IS = (ITEM+48) * 7
109C    02F8            IE = (ITEM+48) * 8 + LEN(MENUS(ITEM))*8
10D9    02FC            LINE (IS,191)-(IE,199),1,B
1101    02FC            RETURN
1105    02FC
1105    02FC    ITEMBOXERASE:
110A    02FC            LINE (IS,191)-(IE,199),0,B
1131    02FC            RETURN
1135    02FC
1135    02FC    PLACECURSOR:
113A    02FC            PUT (XZ+1,YZ+1),CURSOR%
1157    02FC            RETURN
1158    02FC
1158    02FC    MOUSEACT:
1160    02FC            GOSUB ANYKEY
1166    02FC            DXZ = 0 : DYZ = 0
1174    0300            IF A$ = CHR$(0) + CHR$(72) THEN DYZ = -1:RETURN
119D    0300            IF A$ = CHR$(0) + CHR$(80) THEN DYZ =  1:RETURN
11C6    0300            IF A$ = CHR$(0) + CHR$(77) THEN DXZ =  1:RETURN
11EF    0300            IF A$ = CHR$(0) + CHR$(75) THEN DXZ = -1:RETURN
1218    0300            IF A$ = "8" THEN DYZ = -20:RETURN
1232    0300            IF A$ = "2" THEN DYZ =  20:RETURN
124C    0300            IF A$ = "4" THEN DXZ = -20:RETURN
1266    0300            IF A$ = "6" THEN DXZ =  20:RETURN
1280    0300            IF A$ = CHR$(27) THEN RETURN
1297    0300            IF A$ = CHR$(13) THEN RETURN
12AE    0300            GOTO MOUSEACT
12B2    0300
12B2    0300    CURSORMOVE:
12B7    0300            GOSUB PLACECURSOR
12BD    0300            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
12CE    0300            XZ = XZ + DXZ : YZ = YZ + DYZ
12E6    0300            IF XZ < 0 THEN XZ = 0
12FB    0300            IF XZ > 311 THEN XZ = 311
1308    0300            IF YZ < 0 THEN YZ = 0
131D    0300            IF YZ > 182 THEN YZ = 182
1330    0300            ON FLAGZ GOSUB DR1, DR2, DR3, DR4
1341    0300            GOSUB DISPCURSOR
1347    0300            RETURN
1348    0300
1348    0300    CORRECT:
1350    0300            LOCATE 25,1:PRINT SPACE$(39);
136D    0300            LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
1387    0300    CORLOOP:
138C    0300            GOSUB ANYKEY
1392    0300            IF A$ = "y" OR A$ = "Y" THEN A$ = "Y":GOTO COREXIT
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 13D5   0300          IF A$ = "n" OR A$ = "N" THEN A$ = "N":GOTO CORExIT
 13F8   0300          GOTO CORLOOP
 13FB   0300   CORExIT:
 1400   0300          LOCATE 25,1:PRINT SPACE$(39);
 1410   0300          RETURN
 1421   0300
 1421   0300   DISPCURSOR:
 1426   0300          GOSUB PLACECURSOR
 142C   0300          LOCATE 25,27:PRINT USING "+0.000";XI * GRID;
 1456   0300          PRINT ",";
 1463   0300          PRINT USING "+0.000";YI * GRID;
 1480   0300          RETURN
 1484   0300
 1484   0300
 1484   0300   RD1:
 1489   0300          LINE(SCNDATI(I,1)+4,SCNDATI(I,2)+4)-(SCNDATI(I,3)+4,SCN
                    DATI(I,4)+4)
 1522   0300          RETURN
 1526   0300
 1526   0300   RD2:
 152B   0300          LINE(SCNDATI(I,1)+4,SCNDATI(I,2)+4)-(SCNDATI(I,3)+4,SCN
                    DATI(I,4)+4),,B
 15C4   0300          RETURN
 15C8   0300
 15C8   0300   RD3:
 15CD   0300          LINE(SCNDATI(I,1)+4,SCNDATI(I,2)+4)-(SCNDATI(I,3)+4,SCN
                    DATI(I,4)+4),,BF
 1667   0300          RETURN
 1668   0300
 1668   0300   RD4:
 1670   0300          RADIUSI = SQR((SCNDATI(I,3)-SCNDATI(I,1))^2 + (SCNDATI(
                    I,4)-SCNDATI(I,2))^2)
 16FF   0302          CIRCLE (SCNDATI(I,1)+4,SCNDATI(I,2)+4),RADIUSI,,,,1
 1750   0302          RETURN
 1761   0302
 1761   0302   DR1:
 1766   0302          LINE (XII+4,YII+4)-(XI+4,YI+4)
 17AF   0302          RETURN
 17B3   0302
 17B3   0302   DR2:
 17B8   0302          LINE (XII+4,YII+4)-(XI+4,YI+4),,B
 1801   0302          RETURN
 1805   0302
 1805   0302   DR3:
 180A   0302          LINE (XII+4,YII+4)-(XI+4,YI+4),,BF
 1854   0302          RETURN
 1858   0302
 1858   0302   DR4:
 185D   0302          RETURN
 1861   0302
 1861   0302   ER1:
 1866   0302          LINE (XII+4,YII+4)-(XI+4,YI+4),0
 18AF   0302          RETURN
 18B3   0302
```

```
Reagent Jet Printer                                                    PAGE  14
Pattern Entry/Modification                                             07-05-86
                                                                       10:46:13
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 1883   0302    ER2:
 1888   0302            LINE (X1%+4,Y1%+4)-(X%+4,Y%+4),0,B
 1901   0302            RETURN
 1905   0302
 1905   0302    ER3:
 190A   0302            LINE (X1%+4,Y1%+4)-(X%+4,Y%+4),0,BF
 1954   0302            RETURN
 1958   0302
 1959   0302    ER4:
 195D   0302            RETURN
 1961   0302
 1961   0302    ANYKEY:
 1965   0302            A$ = ""
 1970   0302            WHILE A$ = ""
 197F   0302                  A$ = INKEY$
 1989   0302            WEND
 198C   0302            RETURN
 1990   0302
 1990   0302    GETNAME:        'prompt for and get filename
 1995   0302            LOCATE 25,1:PRINT SPACE$(39);
 1982   0302            LOCATE 25,38:PRINT "<:";:       'boundry chevron
 19CC   0302            LOCATE 25,1:PRINT "Enter Pattern Name    ";
 19E6   0302            LINE INPUT; "",NAME$
 19F4   0302            RETURN
 19F8   0302
 19F8   0302    ' Data fields used by this module
 19F8   0302
 19F8   0302    MN1:
 19F9   0302            DATA "DIR","LOAD","SAVE","DRAW","REPT","EXIT","",5
 19FF   0302
 19FF   0302    MN2:
 1A04   0302            DATA "LINE","RECT","ERECT","CIRCL","KERN","MAIN","",5
 1A06   0302
 1A06   0302    INSTRUC:
 1A0B   0302            DATA 8,16,"USE ARROWS"
 1A0D   0302            DATA 10,9,"TO SELECT FROM THE MENU"
 1A0F   0302            DATA 14,12,"USE THE ENTER KEY"
 1A11   0302            DATA 16,10,"TO ACTIVATE SELECTION"
 1A13   0302
 1A13   0302    END SUB
 1A1A   0302
 21AF   0302

50426 Bytes Available
43373 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Reagent Jet Printer
Burr-Brown PCI-20000 custom driver                                  PAGE  1
                                                                    06-30-86
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00  02:38:16
                                                                    08:38:16
0030    0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Burr-Brown PCI-2000
                0 custom driver'
0030    0006    '
0030    0006    'MODULE   - "PCI" Driver for the PCI-20000 I/O and PULSE cards
0030    0006    '
0030    0006    'AUTHOR   - M. S. Fairchild of Computing Architects Inc.
0030    0006    '                                113 Fairfield Way
0030    0006    '                                Bloomingdale, Il 60108
0030    0006    '                                312/980-6777
0030    0006    '
0030    0006    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006    '
0030    0006    'REVISION - 1.2 12-16-85 MSF Add digital I/O initalization, and
                output routine
0030    0006    '
0030    0006    '         - 1.1 12-10-85 MSF Move counter module to position 2
0030    0006    '
0030    0006    '         - 1.0 11-22-85 MSF Creation of initial code
0030    0006    '
0030    0006    'SYSTEM   - This code can only be compiled by the BASCOM V2
0030    0006    '           COMPILER, it will not run under the INTERPRETER!!
0030    0006    '
0030    0006    'DESCRIPTION:
0030    0006    '              The PCI module is a group of routines used to a
                ccess
0030    0006    '        the BURR-Brown PCI-20000 board. The supplied software c
                auses
0030    0006    '        the Morostar2000 software to malfunction and will not p
                rivide
0030    0006    '        explicit on, off functions for the counters.  Custom dr
                ivers
0030    0006    '        will be made to provide all of the desired functions.
0030    0006    '
0030    0006    '
0030    0006    '      Address        Register
0030    0006    '      &HC0000 Carrier I.D. / module present (R)
0030    0006    '      &HC0040 Module interrupt status (R)
0030    0006    '      &HC0080 Digital I/O port 0 (R/W)
0030    0006    '      &HC0081 Digital I/O port 1 (R/W)
0030    0006    '      &HC0082 Buffer direction and enable (R/W)
0030    0006    '      &HC0083 Control for ports 0 and 1 (W)
0030    0006    '      &HC00C0 Digital I/O port 2 (R/W)
0030    0006    '      &HC00C1 Digital I/O port 3 (R/W)
0030    0006    '      &HC00C3 Control for ports 2 and 3 (W)
0030    0006    '
0030    0006    '      &HC0200        Read module I.D. (1110 1010)
0030    0006    '      &HC0204        Rate generator low-order 16 bits (0)
0030    0006    '      &HC0205        Rate generator high-order 16 bits (1)
0030    0006    '      &HC0206        Counter 3 count register (2)
0030    0006    '      &HC0207        Rate generator/counter 3 control
0030    0006    '      &HC0208        Counter 0 count register (0)
0030    0006    '      &HC0209        Counter 1 count register (1)
0030    0006    '      &HC020A        Counter 2 count register (2)
0030    0006    '      &HC020B        Counter 0 - 2 control
0030    0006    '      &HC020C        Counter gate control (1 enables, 0 disa
```

```
Reagent Jet Printer                                                    PAGE  2
Burr-Brown PCI-20000 custom driver                                     06-30-86
                                                                       08:38:16
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

                bits:
 0030   0006    '                    bit     function
 0030   0006    '                    0       Rate generator gate
 0030   0006    '                    1       Rate generator gate
 0030   0006    '                    2       Counter 0 gate
 0030   0006    '                    3       Counter 1 gate
 0030   0006    '                    4       Counter 2 gate
 0030   0006    '                    5       Counter 3 gate
 0030   0006    '                    6       Not used
 0030   0006    '                    7       Not used
 0030   0006    '
 0030   0006    '
 0030   0006    'DATA DICTIONARY
 0030   0006    '
 0030   0006    '       COUNT   - Divisor to 2Mhz rate to give desired frequenc
                y or time
 0030   0006    '       COUNTHI         - High order 16 bits of a 32 bit diviso
                r
 0030   0006    '       COUNTLI - Low order 16 bits of a 32 bit divisor
 0030   0006    '       LSBI    - Lower 8 bits of a 16 bit divisor
 0030   0006    '       MSBI    - Upper 8 bits of a 16 bit divisor
 0030   0006    '
 0030   0006    ' Main line code
 0030   0006    '       The main line code is never executed. It's sole purpose
                 it to
 0030   0006    ' declare shared the variables that will be used in the subrout
                ines
 0030   0006    ' so that they will all be defined and hold their values.
 0030   0006
 0030   0006    MAIN:
 0030   0006            DIM SHARED COUNT,COUNTHI,COUNTLI,LSBI,MSBI
 0030   0006
 0030   0006    MAINLOOP:
 0030   0006            GOTO MAINLOOP
 004C   0012
 004C   0012    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
                
004C    0012    'SUBROUTINE     - PCI.INIT
004C    0012    '
004C    0012    'DESCRIPTION:
004C    0012    '       The PCI.INIT subroutine initalizes the PCI hardware.
004C    0012
004C    0012    SUB PCI.INIT STATIC
0053    0012
0053    0012            DEF SEG = &HC000: 'Point segment to PCI-20000 board
005A    0012
005A    0012            POKE &H020C,&H00: 'Disable all software enabled counter
                        s
0063    0012
0063    0012    ' Configure rate generator to 2 Khz
0063    0012
0063    0012            POKE &H0207,&H34: 'Set low rate counter to mode 2
006D    0012            POKE &H0207,&H74: 'Set high rate counter to mode 2
0077    0012            POKE &H0204,&H02: 'Load low rate counter with 16 bits o
                        f 2
0081    0012            POKE &H0204,&H00
008A    0012            POKE &H0205,&H02: 'Load high rate counter with 16 bits
                        of 2
0094    0012            POKE &H0205,&H00
009D    0012            POKE &H020C,&H03: 'Enable rate counters
00A7    0012
00A7    0012    ' Configure dot rate counters (default to 5 Khz)
00A7    0012
00A7    0012            POKE &H0208,&H34: 'Set low dot counter (0) to mode 2
00B1    0012            POKE &H0208,&H74: 'Set high dot counter (1) to mode 2
00BB    0012            POKE &H0208,&H04: 'Load low rate counter with 16 bits o
                        f 4
00C5    0012            POKE &H0208,&H00
00CE    0012            POKE &H0209,&H64: 'Load high rate counter with 16 bits
                        of 100
00D8    0012            POKE &H0209,&H00
00E1    0012
00E1    0012    ' Configure dot pulse with one shot (default to 13 usec)
00E1    0012
00E1    0012            POKE &H0209,&H82: 'Set dot pulse with oneshot (2) to mo
                        de 1
00EB    0012            POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
00F5    0012            POKE &H020A,&H00
00FE    0012
00FE    0012    ' Configure shifted strobe pulse one shot (default to .5 usec)
00FE    0012
00FE    0012            POKE &H0207,&HB2: 'Set shifted strobe onshot (3) to mod
                        e 1
0108    0012            POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
0112    0012            POKE &H0206,&H00
011B    0012
011B    0012    ' Configure port 0 to output and port 1 to input
011B    0012
011B    0012            POKE &H0083,&H82: ' Set up I/O chip
0125    0012            POKE &H0082,&H34: ' Set up direction and enable buffers
012F    0012            POKE &H0080,&H00: ' Dissable print head
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 013E   0012            END SUB
 013F   0012
 013F   0012    REM $PAGEIF:12
 013F   0012    'SUBROUTINE     - DOT.ON
 013F   0012    '
 013F   0012    'DESCRIPTION:
 013F   0012    '       The DOT.ON subroutine enables the dot frequency counter
                s.
 013F   0012
 013F   0012    SUB DOT.ON STATIC
 0146   0012
 0146   0012            POKE &H020C,&H0F: 'Enable dot counters and rate generat
                or
 0150   0012
 0150   0012            END SUB
 0157   0012
 0157   0012    REM $PAGEIF:12
 0157   0012    'SUBROUTINE     - DOT.OFF
 0157   0012    '
 0157   0012    'DESCRIPTION:
 0157   0012    '       The DOT.OFF subrou   e disables the dot counters
 0157   0012
 0157   0012    SUB DOT.OFF STATIC
 015E   0012
 015E   0012            POKE &H020C,&H03: 'Disable dot counters and enable rate
                 generator
 0168   0012
 0168   0012            END SUB
 016F   0012
 016F   0012    REM $PAGEIF:49
```

```
Reagent Jet Printer                                                    PAGE  5
Burr-Brown PCI-20000 custom driver                                     06-30-86
                                                                       08:38:16
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

016F    0012    'SUBROUTINE     - SET.DOT.RATE
016F    0012    '
016F    0012    'DESCRIPTION:
016F    0012    '       The SET.DOT.RATE subroutine loads the dot rate counters
016F    0012    ' with the desired dot frequency. Allowed range is 10,000 to 1
                Hz.
016F    0012    ' The FREQ parameter is a real number in Hz.
016F    0012
016F    0012    SUB SET.DOT.RATE(FREQ) STATIC
0176    0012
0176    0012    ' Limit fregency to in range
0176    0012
0176    0012            IF FREQ < 1 THEN FREQ = 1
018F    0012            IF FREQ > 10000 THEN FREQ = 10000
01A8    0012
01A8    0012    ' Convert to count and check for 16 bit count or 32 bit count
01A8    0012
01A8    0012            COUNT = 2E6 / FREQ
01B8    0012            IF COUNT < 65536! THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
01CF    0012
01CF    0012    ' Process count of 32 bits
01CF    0012
01CF    0012    DIVIDE32:
01D0    0012            COUNTLZ = INT((COUNT/32768!) + 1): 'Stage lower count
01F0    0012            COUNTHZ = INT(COUNT/COUNTLZ): 'Form upper count
020B    0012            GOTO SET.COUNT
020F    0012
020F    0012    ' Process count of 16 bits
020F    0012
020F    0012    DIVIDE16:
0214    0012            COUNTLZ = 2
021B    0012            COUNTHZ = INT(COUNT/2)
0232    0012            GOTO SET.COUNT
0236    0012
0236    0012    ' Send the derived counts out to the counters
0236    0012
0236    0012    SET.COUNT:
0237    0012            LSBZ = COUNTLZ MOD 256: ' Send out low 16 bits
0248    0012            MSBZ = INT(COUNTLZ / 256)
0263    0012            POKE &H0208,LSBZ
0273    0012            POKE &H0208,MSBZ
0283    0012
0283    0012            LSBZ = COUNTHZ MOD 256: 'Send out high 16 bits
0291    0012            MSBZ = INT(COUNTHZ / 256)
02AC    0012            POKE &H0209,LSBZ
02BC    0012            POKE &H0209,MSBZ
02CC    0012
02CC    0012            END SUB
02D3    0012
02D3    0012    REM $PAGEIF:27
```

```
Reagent Jet Printer                                                PAGE  6
Burr-Brown PCI-20000 custom driver                                 06-30-86
                                                                   08:38:16
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

 02D3   0012   'SUBROUTINE     - SET.DOT.WIDTH
 02D3   0012   '
 02D3   0012   'DESCRIPTION:
 02D3   0012   '       The SET.DOT.WIDTH subroutine loads the dot width one sh
                ot
 02D3   0012   ' with the desired dot pulse width. Allowed range is .5 to 16,0
                00 usec.
 02D3   0012   ' The dwidth parameter is a real number in usec.
 02D3   0012
 02D3   0012   SUB SET.DOT.WIDTH(DWIDTH) STATIC
 02DA   0012
 02DA   0012   ' Limit width to in range
 02DA   0012
 02DA   0012         IF DWIDTH < .5 THEN DWIDTH = .5
 02F3   0012         IF DWIDTH > 16000 THEN DWIDTH = 16000
 030C   0012
 030C   0012   ' Convert to count
 030C   0012
 030C   0012         COUNT = DWIDTH / .5
 031A   0012
 031A   0012   ' Send the derived count out to the counter
 031A   0012
 031A   0012         LSBI = INT(COUNT MOD 256): ' Send out 16 bits
 0331   0012         MSBI = INT(COUNT / 256)
 0348   0012         POKE &H020A,LSBI
 0358   0012         POKE &H020A,MSBI
 0368   0012
 0368   0012         END SUB
 036F   0012
 036F   0012   REM $PAGEIF:27
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

036F    0012   'SUBROUTINE     - SET.STROBE.DELAY
036F    0012   '
036F    0012   'DESCRIPTION:
036F    0012   '       The SET.STROBE.DELAY subroutine loads the strobe delay
                one shot
036F    0012   ' with the desired strobe delay time. Allowed range is .5 to 16
                ,000 usec.
036F    0012   ' The delay parameter is a real number in usec.
036F    0012   '
036F    0012   SUB SET.STROBE.DELAY(DELAY) STATIC
0376    0012   '
0376    0012   ' Limit delay to in range
0376    0012   '
0376    0012   '       IF DELAY < .5 THEN DELAY = .5
036F    0012   '       IF DELAY > 16000 THEN DELAY = 16000
03A8    0012   '
03A8    0012   ' Convert to count
03A8    0012   '
03A8    0012   '       COUNT = DELAY / .5
03B6    0012   '
03B6    0012   ' Send the derived count out to the counter
03B6    0012   '
03B6    0012   '       LSB% = INT(COUNT MOD 256): ' Send out 16 bits
03CD    0012   '       MSB% = INT(COUNT / 256)
03E4    0012   '       POKE &H0206,LSB%
03F4    0012   '       POKE &H0206,MSB%
0404    0012   '
0404    0012   '       END SUB
0408    0012   '
040B    0012   REM $PASSIF:16
040B    0012   'SUBROUTINE     - DIGITAL.OUT
040B    0012   '
040B    0012   'DESCRIPTION:
040B    0012   '       The DIGITAL.OUT subroutine sends the passed integer to
                the output
040B    0012   '       port 0.
040B    0012   '
040B    0012   SUB DIGITAL.OUT(BYTE%) STATIC
0412    0012   '
0412    0012   ' Send the byte to the port
0412    0012   '
0412    0012   '       POKE &H0080,BYTE%
0423    0012   '
0423    0012   '       END SUB
042A    0012   '
057F    0012

50426 Bytes Available
48723 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Reagent Jet Printer                                                          PAGE
Pattern Printing                                                             09-1
                                                                             08:4
Offset  Data    Source Line                          IBM Personal Computer BASIC Compiler V
0030    0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Printing' $LINESIZE:132
0030    0006    'MODULE   - 'PATPRINT'
0030    0006    '
0030    0006    'AUTHOR   - M. A. Emerold
0030    0006    '
0030    0006    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030    0006    '
0030    0006    'REVISION - 2.0 07-02-86 MAE Modified for MicroFab Printhead
0030    0006    '         - 1.1 03-07-86 MAE Added notes and final touches
0030    0006    '           1.0 02-03-86 MAE Creation of initial code
0030    0006    '
0030    0006    'SYSTEM   - This code can only be compiled by the BASCOM
0030    0006    '           COMPILER, it will not run under the INTERPRETER!!
0030    0006    '
0030    0006    'DESCRIPTION:
0030    0006    '       The printing module displays a menu in 3 columns of 4 rows each.  The first
0030    0006    '       column has data from the default reagent profile.  The second column has
0030    0006    '       data from the default pattern file.  The third column has standard printing
0030    0006    '       data.  The four arrow keys allow different menu items to be highlighted and
0030    0006    '       the values can be changed with the + or - keys or by entering the new number
0030    0006    '       followed by Enter.  P will cause the pattern to be printed, S will select the
0030    0006    '       notepad, and E will exit to the main program.  On the notepad, any single line
0030    0006    '       entered here will be sent to the printer.  A null line exits the notepad.
0030    0006    '
0030    0006    'DATA DICTIONARY
0030    0006    '       MENU%          Which menu item is highlighted (0-17)
0030    0006    '       DIFF%          Where to move menu highlight in response to arrow key
0030    0006    '       TYPE%          What key was been pressed during main scan
0030    0006    '       ELMNT          Number of elements in current pattern
0030    0006    '       SCRCRT%(50,5)  Array for storing elements in current pattern
0030    0006    '       REPEAT%        Counter for repeat printing the pattern
0030    0006    '       CT%            Counter for stepping through the pattern array during printing
0030    0006    '       RADIUS%        Radius of circle during printing
0030    0006    '       I% T%          Offsets for start row/column position
0030    0006    '       REPI% REPT%    Repeat distances for repeat printing of patterns
0030    0006    '       SI% ST%        Starting I and T positions for solid rectangles
0030    0006    '       EI% ET%        Ending I and T positions for solid rectangles
0030    0006    '       I% J%          Counters used for reading pattern files into the array
0030    0006    '       TEMP%          Register for misc. integers
0030    0006    '       NOTELINE%      Pointer to which line is active in the notepad
0030    0006    '       MENU$(17,1)    Array of strings used to display menu items
0030    0006    '       A$             Single keystroke input destination
0030    0006    '       NOTE$          String entered in notepad and sent to printer
0030    0006    '       KEYBUF$        String entered from main scan and assigned to number of string field
0030    0006    '       REAGNAME$      Name of default reagent
0030    0006    '       PATNAME$       Name of default pattern
0030    0006    '       FILE$          Name of reagent data file and then pattern data file
0030    0006    '       MENU!(1,4)     Array of values used in displaying menu item numbers
0030    0006    '       TEMP           Register for the temporary storage of real numbers
0030    0006    REM $PAGE
```

```
Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-1
                                                                                       08:4
Offset  Data    Source Line                                          IBM Personal Computer BASIC Compiler V
 0026   0006    SUB PATPRINT STATIC
 0047   0006
 0047   0006          DIM SCNDATE(80,5),MENUS(17,1),MENU(17,4)
 0048   0462
 0048   0462          GOSUB INITIALIZE:       'read init. values and set screen
 004E   0462
 004E   0462          WHILE TYPEI <> 1
 0059   0464
 0059   0464            TYPEI = 0
 0060   0464            A$ = ""
 006A   0468
 006A   0468            WHILE A$ = ""
 0079   0468              A$ = INKEY$
 0083   0468            WEND
 008A   0468
 0086   0468            IF A$ = "E" OR A$ = "e" THEN TYPEI = 1:       'exit sub
 0092   0468            IF A$ = "P" OR A$ = "p" THEN TYPEI = 2:       'print pattern
 009E   0468            IF A$ = "+" THEN TYPEI = 3:                   'increment variable
 00F4   0468            IF A$ = "-" THEN TYPEI = 4:                   'decrement variable
 010A   0468            IF A$ = CHR$(0) + CHR$(72) THEN TYPEI = 5:    'up arrow key
 012F   0468            IF A$ = CHR$(0) + CHR$(80) THEN TYPEI = 6:    'down arrow key
 0154   0468            IF A$ = CHR$(0) + CHR$(75) THEN TYPEI = 7:    'left arrow key
 0179   0468            IF A$ = CHR$(0) + CHR$(77) THEN TYPEI = 8:    'right arrow key
 019E   0468            IF A$ > CHR$(47) AND A$ < CHR$(58) THEN TYPEI = 9:' number 0-9
 01D6   0468            IF A$ = "S" OR A$ = "s" THEN TYPEI = 10:      'enter scratchpad
 0202   0468
 0202   0468            ON TYPEI GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
 021F   0468
 021F   0468          WEND
 0220   0468          TYPEI = 0
 022A   0468
 022A   0468          EXIT SUB
 022E   0468
 022E   0468    '********** SUBROUTINES FOR THIS MODULE **********
 022E   0468    T10:    'scratch pad
 0233   0468          SCREEN 0,0,2,2:COLOR 7,0
 0256   0468          LOCATE NOTELINE2,1
 0264   046A    NOTELOOP:
 0269   046A          LINE INPUT NOTE$
 0277   046E          IF NOTE$ = "" THEN SCREEN 0,0,0,0:RETURN
 029F   046E          LPRINT NOTE$
 02AC   046E          IF NOTELINE2 < 24 THEN NOTELINE2 = NOTELINE2 + 1
 02C9   046E          GOTO NOTELOOP
 02D3   046E
 02D3   046E
 02D3   046E    T1:
 02D8   046E          RETURN:                 'exit to print menu, no action
 02DC   046E
 02DC   046E    T3:           'process "+" key
 02DC   046E          IF MENU(MENUZ,0) >= MENU(MENUZ,1) THEN MENU(MENUZ,0) = MENU(MENUZ,1):RETURN:    'check max value
 02DC   0470          MENU(MENUZ,0) = MENU(MENUZ,0) + MENU(MENUZ,2):  'add increment
 0372   0470          COLOR 0,7:GOSUB DISPMENU:RETURN:                      'show new value
 0388   0470
 0388   0470    T4:           'process "-" key
```

```
Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17
                                                                                       08:49
Offset  Data   Source Line                                          IBM Personal Computer BASIC Compiler V2

0382    0470          IF MENU(MENUZ,0) <= MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,2):RETURN:    'check min value
03F2    0470          MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3):  'sub increment
042E    0470          COLOR 0,7:GOSUB DISPMENU:RETURN:                    'show new value
0444    0470
0444    0470    T5:           'process up arrow key
0449    0470          IF MENUZ MOD 6 = 0 THEN RETURN:                'in top row already
045E    0470          DIFFZ = -1:GOSUB NEWMENU:RETURN:        'move pointer up one
046F    0472
046F    0472    T6:           'process down arrow key
0474    0472          IF MENUZ MOD 6 = 5 THEN RETURN:                'in bottom row already
048A    0472          DIFFZ = 1:GOSUB NEWMENU:RETURN:                'move pointer down one
0498    0472
0498    0472    T7:           'process left arrow key
04A0    0472          IF INT(MENUZ / 6) = 0 THEN RETURN       'in left column already
04C0    0472          DIFFZ = -6:GOSUB NEWMENU:RETURN:        'move pointer one left
04D1    0472
04D1    0472    T8:           'process right arrow key
04D6    0472          IF INT(MENUZ / 6) = 2 THEN RETURN       'in right column already
04F9    0472          DIFFZ = 6:GOSUB NEWMENU:RETURN:                'move pointer one right
050A    0472
050A    0472    T9:           'input keys into KEYBUF$ until <cr> is entered
050F    0472          LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0541    0472          KEYBUF$ = A$
054B    0476          WHILE A$ <> CHR$(13)
055E    0476                LOCATE 25,47:PRINT SPACE$(20);
0578    0476                LOCATE 25,47:PRINT KEYBUF$;
0595    0476                A$ = ""
059F    0476                WHILE A$ = ""
05AE    0476                      A$ = INKEY$
05B8    0476                WEND
05B9    0476                IF A$ = CHR$(8) AND LEN(KEYBUF$) > 0 THEN KEYBUF$ = LEFT$(KEYBUF$,LEN(KEYBUF$)-1)
05F8    0476                IF A$ > CHR$(31) THEN KEYBUF$ = KEYBUF$ + A$
061E    0476          WEND
0622    0476          TEMP = VAL(KEYBUF$)     'temp has value of keys input
0632    047A
0632    047A          'round off temp according to step size in menu array
0632    047A          TEMP = INT(TEMP / (MENU(MENUZ,3)) + .5) * MENU(MENUZ,3)
0648    047A
0648    047A          'test TEMP for maximum and minimum values in menu array
0648    047A          IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
0668    047A          IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
06E9    047A
06E9    047A          'insert new value into menu array and update screen
06E9    047A          MENU(MENUZ,0) = TEMP
0705    047A          LOCATE 25,30:PRINT SPACE$(40);
0722    047A          COLOR 0,7:GOSUB DISPMENU
0734    047A          RETURN
0738    047A
0738    047A    T2:   'set Burr-Brown board then print desired pattern
073D    047A
073D    047A          BEEP:COLOR 15,0:LOCATE 25,1
075A    047A          PRINT "Set Potentiometers on Printer....then Press any Key";
0767    047A          A$ = ""
0771    047A          WHILE A$ = ""
```

```
Reagent Jet Printer
Pattern Printing                                                                    PAGE
                                                                                    09-17
                                                                                    08:49
Offset  Data    Source Line                                  IBM Personal Computer BASIC Compiler V2

0780    047A                A$ = INKEY$
078A    047A            WEND
078D    047A            LOCATE 25,1:PRINT SPACE$(79);
07AA    047A
07AA    047A            'enter dac parameters into burr-brown board
07AA    047A            TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
07D3    047A            TEMP = 5:CALL SET.DOT.WIDTH(TEMP)
07ED    047A            TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
0819    047A            CALL DOT.ON
0825    047A
0825    047A            TEMP% = 4
0829    047C            CALL DIGITAL.OUT(TEMP%)
083C    047C            TEMP% = 0:                      'pulse RESET line
0843    047C            CALL DIGITAL.OUT(TEMP%)
0853    047C            TEMP% = 4
085A    047C            CALL DIGITAL.OUT(TEMP%)
086A    047C
086A    047C            J% = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal J% number of times
0893    047E            FOR I% = 1 TO J%
08A0    0480                    TEMP% = 6:              'set HIGHER true
08A7    0480                    CALL DIGITAL.OUT(TEMP%)
08B7    0480                    TEMP% = 4:              'set HIGHER false
08BE    0480                    CALL DIGITAL.OUT(TEMP%)
08CE    0480            NEXT I%
08E0    0482
08E0    0482            'establish COM1: and initialize plotter
08E0    0482            OPEN "COM1:2400,N,8,1,CD 65535" AS #1
08F2    0482            PRINT #1,":IDCS,SP#1,A";
0902    0482
0902    0482            'move nozzle offset and establish new origin
0902    0482            PRINT #1,"AC";
0912    0482
0912    0482            'calculate row/column location, move there, and set new origin
0912    0482            I% = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
0954    0484            Y% = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
0996    0486            PRINT #1,I%;Y%;"D";
0984    0486
0984    0486            'print the pattern using repeat count
0984    0486            REPY% = MENU(8,0) / 0.005
0987    0488            REPI% = MENU(9,0) / 0.005
09FA    048A
09FA    048A            FOR REPEAT% = 0 TO MENU(7,0)
0A1C    048C
0A1C    048C                    'print the pattern
0A1C    048C                    FOR CT% = 0 TO ELNUM% - 1
0A2A    0490                            ON SEGCAT%(CT%,0) GOSUB PLINE, PRECT, FSRECT, PCIRCL
0A4C    0492                    NEXT CT%
0A5E    0492
0A5E    0492                    PRINT #1,"A,0,0,";:     'return to origin
0A6E    0492                    PRINT #1,REPI%;REPY%;"D";: 'move to next pattern
0A8C    0492            NEXT REPEAT%
0AA1    0494
0AA1    0494            PRINT #1,"H";:  'return plotter to original HOME
0AB1    0494
```

```
Reagent Jet Printer                                                    PAGE
Pattern Printing                                                       09-17
                                                                       08:49
                                                  IBM Personal Computer BASIC Compiler V2

Offset  Data    Source Line

0A51    0494            CLOSE #1:       'disable comi:
0A88    0494
0A88    0494            RETURN
0A8C    0494
0A8C    0494    PLINE:
0AC1    0494            PRINT #1,SCNDAT%(CT%,2);SCNDAT%(CT%,1);"D";
0B03    0494            PRINT #1,SCNDAT%(CT%,4);SCNDAT%(CT%,3);"U";
0B45    0494            RETURN
0B49    0494
0B49    0494    PRECT:
0B4E    0494            PRINT #1,SCNDAT%(CT%,2);SCNDAT%(CT%,1);"D";
0B90    0494            PRINT #1,SCNDAT%(CT%,4);SCNDAT%(CT%,1);
0BCC    0494            PRINT #1,SCNDAT%(CT%,4);SCNDAT%(CT%,3);
0C08    0494            PRINT #1,SCNDAT%(CT%,2);SCNDAT%(CT%,3);
0C44    0494            PRINT #1,SCNDAT%(CT%,2);SCNDAT%(CT%,1);"U";
0C86    0494            RETURN
0C8A    0494
0C8A    0494    PCIRCL:
0C8F    0494            RADIUS% = SQR((SCNDAT%(CT%,3)-SCNDAT%(CT%,1))^2 + (SCNDAT%(CT%,4)-SCNDAT%(CT%,2))^2)
0D1A    0496            PRINT #1,"CC ";SCNDAT%(CT%,2);SCNDAT%(CT%,1);RADIUS%;
0D63    0496            RETURN
0D67    0496
0D67    0496    PSRECT:
0D6C    0496            SX% = SCNDAT%(CT%,4):EX% = SCNDAT%(CT%,2)
0DA0    049A            SY% = SCNDAT%(CT%,3):EY% = SCNDAT%(CT%,1)
0DD4    049E            IF EX% <= SX% THEN SX% = SCNDAT%(CT%,2):EX% = SCNDAT%(CT%,4)
0E15    049E            IF EY% <= SY% THEN SY% = SCNDAT%(CT%,1):EY% = SCNDAT%(CT%,3)
0E56    049E
0E56    049E            PRINT #1,SX%;SY%;"D";
0E74    049E
0E74    049E            IF EX% - SX% >= EY% - SY% THEN GOSUB STEPY ELSE GOSUB STEPX
0E9D    049E
0E9D    049E            PRINT #1,"U";
0EAD    049E            RETURN
0EB1    049E
0EB1    049E    STEPY:
0EB6    049E            PRINT #1,EX%;SY%;
0ECE    049E            SY% = SY% + 1
0ED7    049E            IF SY% > EY% THEN RETURN
0EEB    049E            PRINT #1,EX%;SY%;SX%;SY%;
0F0E    049E            SY% = SY% + 1
0F17    049E            IF SY% > EY% THEN RETURN
0F2B    049E            PRINT #1,SX%;SY%;
0F40    049E            GOTO STEPY
0F44    049E
0F44    049E    STEPX:
0F49    049E            PRINT #1,SX%;EY%;
0F61    049E            SX% = SX% + 1
0F6A    049E            IF SX% > EX% THEN RETURN
0F7B    049E            PRINT #1,SX%;EY%;SX%;SY%;
0FA1    049E            SX% = SX% + 1
0FAA    049E            IF SX% > EX% THEN RETURN
0FBB    049E            PRINT #1,SX%;SY%;
0FD3    049E            GOTO STEPX
```

```
Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17
                                                                                       08:49
Offset  Data   Source Line                                  IBM Personal Computer BASIC Compiler V2

0F37   049E
0F37   049E   NEWMENU: 'write old item in yellow, point to and highlight new item
0FDC   049E           COLOR 14,0:GOSUB DISPMENU
0FEE   049E           MENUI = MENUI + DIFFI
0FFA   049E           IF MENUI = 10 THEN MENUI = 9
100C   049E           IF MENUI = 11 THEN MENUI = 9
101E   049E           IF MENUI > 15 THEN MENUI = 15
1030   049E           COLOR 0,7:GOSUB DISPMENU:RETURN
1046   049E
1046   049E   INITIALIZE:
1046   049E           'change to screen 0 and display messages
1048   049E           SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
108F   049E           LOCATE 12,33:PRINT "Please Wait..."
10A9   049E
10A9   049E           'initialize notepad on screen 2
10A9   049E           SCREEN 0,0,2,1:CLS:COLOR 15
10CE   049E           PRINT"Digital Notepad - - -All information typed here is sent to the printer"
10D8   049E           NOTELINEI = 3
10E2   049E
10E2   049E           'initialize menu arrays
10E2   049E           RESTORE ARRDATA
10E9   049E           FOR II=0 TO 17
10EF   049E                   READ MENUS(II,0),MENUS(II,1)
111F   049E                   READ MENU(II,0),MENU(II,1),MENU(II,2),MENU(II,3),MENU(II,4)
1180   049E           NEXT II
1193   049E
1193   049E           'get default reagent file and read values
1193   049E
1193   049E           OPEN "REAGEF.RJP" FOR INPUT AS #1
11A4   049E           INPUT #1,FILES
11B6   04A2           INPUT #1,REANAMES
11C8   04A6           CLOSE #1
11CF   04A6
11CF   04A6           OPEN FILES FOR INPUT AS #1:     'get reagent data
11E0   04A6           INPUT #1,MENU(0,0):             'frequency
1200   04A6           INPUT #1,MENU(1,0):             'amplitude
1223   04A6           INPUT #1,MENU(2,0):             'strobe delay
1246   04A6           INPUT #1,MENU(3,0):             'pulse width
1269   04A6           INPUT #1,MENU(4,0):             'rise time
128C   04A6           INPUT #1,MENU(5,0):             'fall time
12B1   04A6           CLOSE #1
12B8   04A6
12B8   04A6           'get default pattern file and read values
12B8   04A6
12B8   04A6           OPEN "PATDEF.RJP" FOR INPUT AS #1
12C9   04A6           INPUT #1,FILES
12DB   04AA           INPUT #1,PATNAMES
12ED   04AA           CLOSE #1
12F4   04AA
12F4   04AA           OPEN FILES FOR INPUT AS #1:     'get pattern data
1305   04AA           INPUT #1,ELMNTS
1317   04AA           INPUT #1,MENU(6,0):             'grid
132A   04AA           INPUT #1,MENU(7,0):             'repeat count
1350   04AA           INPUT #1,MENU(8,0):             'x offset
```

```
Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17
                                                                                       08:49
Offset  Data    Source Line                                  IBM Personal Computer BASIC Compiler V2

1380    04AA            INPUT #1,MENU(9,0):             'y offset
13A3    04AA            FOR IZ = 0 TO ELNUMZ-1
13B1    04AC                    FOR JZ = 0 TO 5
13B7    04AC                            INPUT #1,SCNDATZ(IZ,JZ)
13D8    04AC                    NEXT JZ
13EB    04AC            NEXT IZ
13FD    04AC            CLOSE #1

1404    04AC
1404    04AC            'set remaining parameters in menu array
1404    04AC
1404    04AC            MENU(12,0) = 1:                 'row 1
1420    04AC            MENU(13,0) = 1:                 'column 1
143C    04AC            MENU(14,0) = 0:                 'row spacing
1458    04AC            MENU(15,0) = 0:                 'column spacing
1474    04AC
1474    04AC            'change active displayed screen to screen 0 to draw and display parameters
1474    04AC
1474    04AC            SCREEN 0,0,0,1:CLS
1491    04AC
1491    04AC            COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";
1482    04AC            COLOR 9
14B9    04AC            FOR I=2 TO 79
14C3    04AC                    LOCATE 3,I:PRINT CHR$(196);:LOCATE 5,I:PRINT CHR$(205);:LOCATE 18,I:PRINT CHR$(196);
1523    04B0            NEXT I
153E    04B0            FOR I=4 TO 17
1548    04B0                    LOCATE I,1:PRINT CHR$(179);:LOCATE I,28:PRINT CHR$(186);:LOCATE I,54:PRINT CHR$(186);:LOCATE I,5
RINT CHR$(179);
15C8    04B0            NEXT I
15E6    04B0            RESTORE TABLE
15ED    04B0            FOR I=1 TO 12
15F7    04B0                    READ RZ,CZ,NZ:LOCATE RZ,CZ:PRINT CHR$(NZ);
162A    04B6            NEXT I
1645    04B6
1645    04B6            'display 16 menu choices in yellow
1645    04B6
1645    04B6            COLOR 14,0
1651    04B6            FOR MENUZ = 0 TO 15
1657    04B6                    GOSUB DISPMENU
1659    04B6            NEXT MENUZ
1660    04B6
1660    04B6            'set for first menu entry and highlight it
1660    04B6            MENUZ = 0:COLOR 0,7
1680    04B6            GOSUB DISPMENU
1686    04B6
1686    04B6            'print three headings and instructions
1686    04B6            COLOR 10,0
1692    04B6            LOCATE 4,14.5-LEN(REANAME$)/2:PRINT REANAME$;
16C1    04B6            LOCATE 4,41-LEN(PATNAME$)/2:PRINT PATNAME$;
16F0    04B6            LOCATE 4,60:PRINT "PRINT LOCATION";
170A    04B6
170A    04B6            COLOR 7:LOCATE 19,20:PRINT "Use ";:COLOR 15:PRINT CHR$(27);CHR$(32);CHR$(26);
1754    04B6            PRINT CHR$(32);CHR$(24);CHR$(32);CHR$(25);:COLOR 7:PRINT " to position highlighted cursor";
1793    04B6            LOCATE 20,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
17E9    04B6            COLOR 7:PRINT" to scroll current value up or down";
```

```
Reagent Jet Printer                                                                    PAGE
Pattern Printing                                                                       09-17-
                                                                                       08:49:
Offset  Data    Source Line                                          IBM Personal Computer BASIC Compiler V2.

17F0    0486            LOCATE 21,5:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
183F    0486            COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
1867    0486            PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
189C    0486
189C    0486            'set screen to view menu just created and exit
189C    0486
189C    0486            SCREEN 0,0,0,0
18B1    0486            RETURN
18B5    0486
18B5    0486    DISPMENU:
18BA    0486            IF MENUZ = 10 OR MENUZ = 11 THEN RETURN
18DE    0486            LOCATE (MENUZ MOD 6)*2+7,(INT(MENUZ/6)*28+2)-2*INT(MENUZ/12)
1938    0486            PRINT MENU$(MENUZ,0)
1956    0486            LOCATE (MENUZ MOD 6)*2+7,MENU(MENUZ,4)
1959    0486            PRINT USING MENU$(MENUZ,1);MENU(MENUZ,0);
1978    0486            RETURN
197F    0486    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  09-17
Pattern Printing                                                       08:45
                                                IBM Personal Computer BASIC Compiler V2

 Offset  Data   Source Line

  19BF   0486   '************ DATA USED BY THIS MODULE ************
  19BF   0486
  19BF   0486   ARRDATA:
  19C4   0486           DATA "Dot Frequency          Hz",".##,###",10000,1,1,16
  19C6   0486           DATA "Amplitude              V ",".###",150,0,1,19
  19C8   0486           DATA "Strobe Delay           uS",".##,###.#",15999.5,.5..5,16
  19CA   0486           DATA "Pulse Width              ",".###",999,0,1,19
  19CC   0486           DATA "Rise Time                ",".###",999,0,1,19
  19CE   0486           DATA "Fall Time                ",".###",999,0,1,19
  19D0   0486           DATA "Grid Size              in",".#.###",.005..005..005,45
  19D2   0486           DATA "Repeat Count             ",".##",99,0,1,47
  19D4   0486           DATA "X Axis Offset          in",".#.###",2,0,.005,45
  19D6   0486           DATA "Y Axis Offset          in",".#.###",2,0,.005,45
  19D8   0486           DATA "","",0,0,0,0
  19DA   0486           DATA "","",0,0,0,0
  19DC   0486           DATA "Row to Print           ","##",99,1,1,74
  19DE   0486           DATA "Colusn to Print        ","##",99,1,1,74
  19E0   0486           DATA "Row Spacing              in",".#.###",3,0,.005,72
  19E2   0486           DATA "Colusn Spacing           in",".#.###",3,0,.005,72
  19E4   0486           DATA "","",0,0,0,0
  19E6   0486           DATA "","",0,0,0,0
  19E8   0486
  19E8   0486   TABLE:
  19ED   0486           DATA 3,1,218
  19EF   0486           DATA 3,28,210
  19F1   0486           DATA 3,54,210
  19F3   0486           DATA 3,80,191
  19F5   0486           DATA 5,1,198
  19F7   0486           DATA 5,28,206
  19F9   0486           DATA 5,54,206
  19FB   0486           DATA 5,80,181
  19FD   0486           DATA 18,1,192
  19FF   0486           DATA 18,28,208
  1A01   0486           DATA 18,54,208
  1A03   0486           DATA 18,80,217
  1A05   0486
  1A05   0486   END SUB
  1A0C   0486
  1A0C   0486
  2069   0486

 50426 Bytes Available
 44716 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

```
Reagent Jet Printer
Reagent Filing                                                    PAGE  1
                                                                  07-09-86
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00  15:04:35

0030  0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Filing'
0030  0006    'MODULE   - "REAFILE" File Handling for reagents
0030  0006    '
0030  0006    'AUTHOR   - N. A. Enevold
0030  0006    '
0030  0006    'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030  0006    '
0030  0006    'REVISION - 1.1 03-07-86 NAE Added notes and description
0030  0006    '           1.0 02-14-86 NAE Creation of initial code
0030  0006    '
0030  0006    'SYSTEM   - This code can only be compiled by the BASCOM
0030  0006    '           COMPILER, it will not run under the INTERPRETER!!
0030  0006    '
0030  0006    'DESCRIPTION:
0030  0006    '       This module allow file handling for reagents.  When inv
                oked, it displays
0030  0006    '       the current contents of the reagent directory in 4 colu
                ans of 20 entries
0030  0006    '       each.  The reagent which is currently selected for prin
                ting is marked by
0030  0006    '       an asterisk to the left of the reagent name.  After the
                 directory is listed
0030  0006    '       the user is presented with 5 menu choices.  The left an
                d right arrows are
0030  0006    '       used to highlight menu items and the enter key is used
                to invoke action.
0030  0006    '       The menu choices and their actions are:
0030  0006    '
0030  0006    '               DELETE - Remove a reagent file from the directo
                ry
0030  0006    '               COPY -   Copy a reagent file to a new reagent n
                ame, saving the old reagent
0030  0006    '               RENAME - Change the name of the reagent without
                 changing the reagent itself
0030  0006    '               SELECT - Selct a reagent for printing
0030  0006    '               EXIT -   Return to the main menu
0030  0006    '
0030  0006    'DATA DICTIONARY
0030  0006    '       TYPE%     Which type of valid key was pushed
0030  0006    '       MENU%     Which menu item is being pointer to (0-4)
0030  0006    '       DIFF%     Distance to move MENU% at left or right arro
                w
0030  0006    '       FLAG%     Error type 0-4
0030  0006    '       POINTER%  Position of REANAME$ in directory list
0030  0006    '       REANUM%           Number of reagent names in directory
                list
0030  0006    '       TEMP%     Storage for integers during reagent copy
0030  0006    '       A$        Misc. input string
0030  0006    '       FUNCT$    Printed at bottom of screen during prompt fo
                r reagent name
0030  0006    '       REANAME$  Reagent name currently being worked on
0030  0006    '       SELNAME$  Reagent name currently selected for printing
0030  0006    '       FILE$     Filename of reagent data file
0030  0006    '       SFILE$    Filename for source reagent data file used d
```

```
Reagent Jet Printer                                                    PAGE   2
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

                during copy
 0030   0006    '       DFILE$      Filename for destination reagent data file u
                ses during copy
 0030   0006    '       NEWNAME$    New reagent name for COPY and RENAME
 0030   0006    '       TEMP$       Reagent names are held here as the directory
                 is being re-written
 0030   0006    '       NEWFILE$    Destination filename used while copying reag
                ent data files
 0030   0006    '       MESSAGE$    A message printed at the bottom of the scree
                n
 0030   0006    '       MENU$(4,1) Array of strings containing the short and lo
                ng menu names
 0030   0006    '       ERRMSG$     Message printed when any error occurs
 0030   0006    '       ERR$        Appended to ERRMSG$ to indicate nature of er
                ror
 0030   0006    REM $PAGE


Reagent Jet Printer                                                    PAGE   3
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0030   0006    SUB REAGENT.FILE STATIC
 0047   0006
 0047   0006            GOSUB INITIALIZE
 004D   0006            TYPE% = 0
 0054   0008
 0054   0008            WHILE TYPE% <> 3
 005F   0008                    A$ = ""
 0069   000C                    WHILE A$ = ""
 0078   000C                            A$ = INKEY$
 0082   000C                    WEND
 0085   000C                    IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 1:
                'left arrow
 00AA   000C                    IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 2:
                'right arrow
 00CF   000C                    IF A$ = CHR$(13) THEN TYPE% = 3:
                '(cr) to execute selection
 00E9   000C
 00E9   000C                            ON TYPE% GOSUB T1, T2, T3
 00F8   000C            WEND
 00FC   000C
 00FC   000C            EXIT SUB
 0100   000C
 0100   000C    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE   4
Reagent Filing                                                         07-09-86
                                                                       15:04:35
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0100   0000    '******** SUB-ROUTINES FOR THIS MODULE ********
 0100   0000
 0100   0000    T1:              'left arrow
 0105   0000            TYPE1 = 0
 010C   0000            IF MENU% = 0 THEN RETURN
 0118   0000            DIFF1 = -1
 0122   0010            GOSUB NEW.MENU
 0128   0010            RETURN
 012C   0010
 012C   0010    T2:              'right arrow
 0131   0010            TYPE1 = 0
 0138   0010            IF MENU% = 4 THEN RETURN
 0147   0010            DIFF1 = 1
 014E   0010            GOSUB NEW.MENU
 0154   0010            RETURN
 0158   0010
 0153   0010    T3:              '(cr)  (execute selected menu item)
 015D   0010            LOCATE 25,1:PRINT SPACE$(79);
 017A   0010            ON MENU% + 1 GOSUB T3A, T3B, T3C, T3D, T3E
 018F   0010            GOSUB MENU.ON
 0195   0010            RETURN
 0199   0010
 0199   0010    REM $PAGE
```

```
Offset  Data    Source Line
0199    0010    T3A:            'delete reagent
019E    0010            TYPE% = 0
01A5    0010            FUNCT$ = "Delete"
01AF    0014            GOSUB GET.SOURCE
01B5    0014            IF LEN(REANAME$) = 0 THEN RETURN
01C7    0018            IF REANAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                RETURN
01E7    001E            GOSUB SEARCH
01ED    001E            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
0209    0020
0209    0020            MESSAGE$ = "Deleting " + REANAME$ + "     Please Wait..
                ."
0220    0024            GOSUB MESSAGE.ON
0226    0024
0226    0024                    'rewrite directory deleting REANAME$ as indicat
                ed by POINTER%
0226    0024            KILL "READIR.OLD"
022D    0024            NAME "READIR.RJP" AS "READIR.OLD"
0237    0024            OPEN "READIR.OLD" FOR INPUT AS #1
0248    0024            OPEN "READIR.RJP" FOR OUTPUT AS #2
025A    0024
025A    0024            INPUT #1, REANUM%
026C    0026            REANUM% = REANUM% - 1
0275    0026            WRITE #2,REANUM%
0286    0026
0286    0026            IF REANUM% = 0 THEN GOTO DIR.DONE
0295    0026            FOR I% = 1 TO REANUM% + 1
02A4    0028                    INPUT #1,REANAME$
02B6    0028                    IF I% <> POINTER% THEN PRINT #2,REANAME$
02D3    002A            NEXT I%
02E5    002A
02E5    002A    DIR.DONE:
02EA    002A            CLOSE #1:CLOSE #2
02F8    002A
02F8    002A                    'remove data file
02F8    002A            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                "REA.RJP"
031C    002E            KILL FILE$
0323    002E
0323    002E                    'rename remaining data files to maintain linked
                 list to directory
0323    002E            WHILE (REANUM% + 1) > POINTER%
0333    002E                    SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                ER%+1))-1) + "REA.RJP"
0359    0032                    DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                %))-1) + "REA.RJP"
037D    0036                    NAME SFILE$ AS DFILE$
0387    0036                    POINTER% = POINTER% + 1
0390    0036            WEND
0393    0036
0393    0036            GOSUB MESSAGE.OFF
0399    0036            REANAME$ = SELNAME$
03A3    0036            GOSUB T3DA
03A9    0036            GOSUB DISP.DIR
```

Reagent Jet Printer
Reagent Filing


```
Offset  Data    Source Line
 03AF   0036            RETURN
 03B3   0036
 03B3   0036    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
 5
 0383   0036    T38:    'copy reagent
 0388   0036            TYPE% = 0
 038F   0036            IF REANUM% = 60 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
 03DB   0036            FUNCT$ = "Copy"
10 03E5 0036            GOSUB GET.SOURCE
 03EB   0036            IF LEN(REANAME$) = 0 THEN RETURN
 03FD   0036            GOSUB SEARCH
 0403   0036            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 041F   0036
15 041F 0036            GOSUB GET.NEW.NAME
 0425   0036            IF LEN(NEWNAME$) = 0 THEN RETURN
 0437   003A            IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                      ETURN
 0457   003A
20 0457 003A            MESSAGE$ = "Copying " + REANAME$ + " to " + NEWNAME$ +
                      "    Please wait.."
 047C   003A            GOSUB MESSAGE.ON
 0482   003A
 0482   003A                    'add new name at end of directory
25 0482 003A            KILL "READIR.OLD"
 0489   003A            NAME "READIR.RJP" AS "READIR.OLD"
 0493   003A            OPEN "READIR.OLD" FOR INPUT AS #1
 04A4   003A            OPEN "READIR.RJP" FOR OUTPUT AS #2
 04B6   003A
30 04B6 003A            INPUT #1, REANUM%
 04CB   003A            REANUM% = REANUM% + 1
 04D1   003A            WRITE #2,REANUM%
 04E2   003A
 04E2   003A            FOR I% = 1 TO REANUM% - 1
35 04F1 003C                    INPUT #1,TEMP$
 0503   0040                    PRINT #2,TEMP$
 0513   0040            NEXT I%
 0525   0040            PRINT #2,NEWNAME$
 0535   0040
40 0535 0040            CLOSE #1:CLOSE #2
 0543   0040
 0543   0040                    'create copy of data file
 0543   0040            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                      "REA.RJP"
45 0567 0040            NEWFILE$ = RIGHT$(STR$(REANUM%),LEN(STR$(REANUM%))-1) +
                      "REA.RJP"
 0588   0044
 0588   0044            OPEN FILE$ FOR INPUT AS #1
 059C   0044            OPEN NEWFILE$ FOR OUTPUT AS #2
50 05AE 0044
 05AE   0044            INPUT #1,TEMP
 05C0   0048            WRITE #2,TEMP:  'frequency
 05D0   0048            INPUT #1,TEMP
 05E2   0048            WRITE #2,TEMP:  'pulse width
55 05F2 0048            INPUT #1,TEMP
 0604   0048            WRITE #2,TEMP:  'strobe delay
 0614   0048            INPUT #1,TEMP
 0626   0048            WRITE #2,TEMP:  'nozzle
 0636   0048
```

Reagent Jet Printer
Reagent Filing

Offset Data Source Line IBM Personal Cocuter BASIC Compiler V2.00

```
0636  0048          INPUT #1,TEMP$
0648  0048          PRINT #2,TEMP$:        'concentration
065B  0048          INPUT #1,TEMP$
066A  0048          PRINT #2,TEMP$:        'density
067A  0048          INPUT #1,TEMP$
068C  0048          PRINT #2,TEMP$:        'viscosity
069C  0048
069C  0048          CLOSE #1:CLOSE #2
06AA  0048
06AA  0048          GOSUB MESSAGE.OFF
06B0  0048          GOSUB DISP.DIR
06B6  0048          RETURN
06BA  0048
06BA  0048    REM $PAGE
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
06BA  0046  TCC:    'renaae reagent
06BF  0048          TYPE% = 0
06C6  0048          FUNCT$ = "Renaae"
06D0  0048          GOSUB GET.SOURCE
06D6  0048          IF LEN(REANAME$) = 0 THEN RETURN
06E3  0048          GOSUB SEARCH
06EE  0048          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
070A  0048
070A  0048          GOSUB GET.NEW.NAME
0710  0048          IF LEN(NEWNAME$) = 0 THEN RETURN
0722  0048          IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                  ETURN
0742  0048          IF NEWNAME$ = REANAME$ THEN RETURN
0755  0048          MESSAGE$ = "Renaaing " + REANAME$ + " to " + NEWNAME$ +
                   "    Please wait.."
077A  0046          GOSUB MESSAGE.ON
0780  0048
0790  0048                  'renaaing reagent naae in directory
0780  0048          KILL "READIR.OLD"
0787  0048          NAME "READIR.RJP" AS "READIR.OLD"
0791  0048          OPEN "READIR.OLD" FOR INPUT AS #1
07A2  0048          OPEN "READIR.RJP" FOR OUTPUT AS #2
07B4  0048
07B4  0048          INPUT #1, REANUM%
07C6  0048          WRITE #2,REANUM%
07D7  0048
07D7  0048          FOR I% = 1 TO REANUM%
07E4  004A                  INPUT #1,TEMP$
07F6  004A                  IF I% <> POINTER% THEN PRINT #2,TEMP$
0813  004A                  IF I% = POINTER% THEN PRINT #2,NEWNAME$
0830  004A          NEXT I%
0842  004A
0842  004A          CLOSE #1:CLOSE #2
0850  004A
0850  004A          GOSUB MESSAGE.OFF
0856  004A          IF REANAME$ = SELNAME$ THEN REANAME$ = NEWNAME$:GOSUB T
                  SDA
0875  004A          GOSUB DISP.DIR
087B  004A          RETURN
087F  004A
087F  004A    REM $PAGE
```

```
Offset  Data   Source Line        IBM Personal Computer BASIC Compiler V2.00

 0677   004A   TJD:    'select reagent for printing
 067A   004A            'TFEZ = 0
 067E   004A            FUNCT$ = "Select"
 0695   004A            GOSUB GET.SOURCE
 0698   004A            IF LEN(REANAME$) = 0 THEN RETURN
 06A0   004A            IF REANAME$ = SELNAME$ THEN RETURN
 06C0   004A            GOSUB TJDA
 06C6   004A            GOSUB DISP.DIR
 06CC   004A            RETURN
 06D0   004A
 06D0   004A   TJDA:
 06D5   004A            GOSUB SEARCH
 06D6   004A            IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
 06F7   004A
 06F7   004A            MESSAGE$ = "Selecting " + REANAME$ + "     Please Wait.
                  .."
 090E   004A            GOSUB MESSAGE.ON
 0914   004A
 0914   004A                    'change entrys in reagent default file READEF.R
                  JP
 0914   004A            OPEN "READEF.RJP" FOR OUTPUT AS #1
 0926   004A            FILE$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
                  "REA.RJP"
 094A   004A
 094A   004A            PRINT #1,FILE$
 095A   004A            PRINT #1,REANAME$
 096A   004A
 096A   004A            CLOSE #1
 0971   004A            GOSUB MESSAGE.OFF
 0977   004A            RETURN
 097B   004A
 097B   004A   TJE:     'exit reagent filing
 0980   004A            RETURN
 0984   004A
 0984   004A   REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0984   004A  SEARCH:
 0987   004A        POINTER% = 0
 0990   004A        OPEN "READIR.RJP" FOR INPUT AS #1
 09A1   004A        INPUT #1,REANUM%:'      get number of reagents in direc
                tory
 09B3   004A        IF REANUM% = 0 THEN CLOSE #1:RETURN
 09C9   004A        TEMP$ = ""
 09D3   004A        WHILE (POINTER% < REANUM%) AND (REANAME$ <> TEMP$)
 09F8   004A              LINE INPUT #1,TEMP$
 0A0E   004A              POINTER% = POINTER% + 1
 0A11   004A        WEND
 0A14   004A        IF REANAME$ <> TEMP$ THEN POINTER% = 0
 0A2A   004A        CLOSE #1
 0A31   004A        RETURN
 0A35   004A
 0A35   004A  GET.SOURCE:
 0A3A   004A        LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to "FU
                NCT$"  ";
 0A6C   004A        LINE INPUT;"",REANAME$
 0A7A   004A        LOCATE 25,1:PRINT SPACE$(79);
 0A97   004A        RETURN
 0A9B   004A
 0A9B   004A  GET.NEW.NAME:
 0AA0   004A        LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";
 0AC6   004A        LINE INPUT;"",NEWNAME$
 0AD4   004A        LOCATE 25,1:PRINT SPACE$(79);
 0AF1   004A        RETURN
 0AF5   004A
 0AF5   004A  DISP.DIR:        'display reagent directory in 4 columns of 20 r
                ows
 0AFA   004A                   'read selected reagent into SELNAME$
 0AFA   004A        OPEN "READEF.RJP" FOR INPUT AS #1
 0B0B   004A        INPUT #1,SELNAME$:      'read and discard data file nam
                e
 0B1D   004A        INPUT #1,SELNAME$:      'read and save reagent name
 0B2F   004A        CLOSE #1
 0B36   004A
 0B36   004A        OPEN "READIR.RJP" FOR INPUT AS #1
 0B47   004A        INPUT #1,REANUM%:'      read number of reagents
 0B5F   004A        MESSAGE$ = "Reading Reagent Directory  Please Wait"
 0B63   004A        GOSUB MESSAGE.ON
 0B69   004A        FLAG% = 0
 0B70   004A        TEMP% = REANUM% - 1:IF REANUM% < 80 THEN TEMP% = REANUM
                %
 0B88   004C        FOR I% = 0 TO TEMP%
 0B97   004E              LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
 0BCA   004E              PRINT SPACE$(18);
 0BDA   004E        NEXT I%
 0BEC   004E
 0BEC   004E        FOR I% = 0 TO REANUM% - 1
 0BFA   0050              INPUT #1,REANAME$
 0C0C   0050              LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
 0C3F   0050              PRINT REANAME$;
 0C4C   0050              IF REANAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
                    ;,(INT(IZ/20)*80)+1:PRINT "*";
0C98  0050                NEXT IZ
0CB0  0050                CLOSE #1
0CB7  0050                GOSUB MESSAGE.OFF
0CBD  0050                RETURN
0CC1  0050
0CC1  0050  INITIALIZE:
0CC6  0050                DIM MENUS(4,1)
0CC7  0078                MENUS(0,0) = "Delete"
0CDF  0078                MENUS(0,1) = "Remove a reagent file from the directory"
0CFA  0078                MENUS(1,0) = "Copy"
0D15  0078                MENUS(1,1) = "Copy a reagent file to a new reagent name
0D2E  0078                MENUS(2,0) = "Rename"
0D48  0078                MENUS(2,1) = "Rename a reagent file in the directory"
0D69  0078                MENUS(3,0) = "Select"
0D84  0078                MENUS(3,1) = "Select a reagent file to be printed"
0DA0  0078                MENUS(4,0) = "Exit"
0DB8  0078                MENUS(4,1) = "Return to the main menu"
0DD7  0078
0DD7  0078                COLOR 9,0:CLS
0DEA  0078                LOCATE 21,1
0DF7  0078                FOR IZ = 1 TO 80
0DFE  0078                      PRINT "D";
0E0B  0078                NEXT IZ
0E1B  0078
0E1B  0078                FOR MENUZ = 0 TO 4
0E21  0078                      GOSUB MENU.OFF
0E27  0078                NEXT MENUZ
0E37  0078
0E37  0078                GOSUB DISP.DIR
0E3D  0078                IF FLAGZ > 0 THEN GOSUB SHOW.ERROR
0E4E  0078                MENUZ = 4
0E55  0078                GOSUB MENU.ON
0E5B  0078
0E5B  0078                RETURN
0E5F  0078
0E5F  0078  NEW.MENU:
0E64  0078                GOSUB MENU.OFF
0E6A  0078                MENUZ = MENUZ + DIFFZ
0E76  0078                GOSUB MENU.ON
0E7C  0078                RETURN
0E80  0078
0E80  0078  MENU.ON:
0E85  0078                LOCATE 22,(MENUZ*10)+18
0E9C  0078                COLOR 0,7
0EA8  0078                PRINT MENUS(MENUZ,0);
0EC6  0078                LOCATE 25,40-LEN(MENUS(MENUZ,1))/2
0EFA  0078                COLOR 7,0
0F06  0078                PRINT MENUS(MENUZ,1);
0F25  0078                RETURN
0F29  0078
0F29  0078  MENU.OFF:
0F2E  0078                LOCATE 22,(MENUZ*10)+18
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0F45   0078            COLOR 14,0
 0F51   0078            PRINT MENU$(MENUX,0);
 0F6F   0078            LOCATE 25,40-LEN(MENU$(MENUX,1))/2
 0FA3   0078            PRINT SPACE$(LEN(MENU$(MENUX,1)));
 0FC8   0078            RETURN
 0FCC   0078
 0FCC   0078    SHOW.ERROR:
 0FD1   0078            ON FLAGX GOSUB ER1, ER2, ER3, ER4
 0FE2   0078            ERRMSG$ = ERR$ + "     Strike any key.."
 0FF2   0080            LOCATE 24,40-LEN(ERRMSG$)/2
 1014   0080            COLOR 13,0
 1020   0080            PRINT ERRMSG$;
 102D   0080            A$ = ""
 1037   0080            WHILE A$ = ""
 1046   0080                  A$ = INKEY$
 1050   0080            WEND
 1053   0080            GOSUB MESSAGE.OFF
 1059   0080            RETURN
 105D   0080
 105D   0080    ER1:
 1062   0080            ERR$ = REANAME$ + " Not Found in the Directory"
 1072   0080            RETURN
 1076   0080
 1076   0080    ER2:
 107B   0080            ERR$ = "Reagent Name is too Long (15 characters max.)"
 1085   0080            RETURN
 1089   0080
 1089   0080    ER3:
 108E   0080            ERR$ = "Directory is Full (80 reagents max.)"
 1098   0080            RETURN
 109C   0080
 109C   0080    ER4:
 10A1   0080            ERR$ = "Cannot Modify SELECTd reagent Name"
 10AB   0080            RETURN
 10AF   0080
 10AF   0080    MESSAGE.ON:
 10B4   0080            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                GE$;
 10EF   0080            RETURN
 10F3   0080
 10F3   0080
 10F3   0080    MESSAGE.OFF:
 10FB   0080            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 1121   0080            RETURN
 1125   0080
 1125   0080    END SUB
 112C   0080
 16C9   0080

50426 Bytes Available
45718 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Reagent Jet Printer                                                    PAGE  1
Pattern Filing                                                         07-09-86
                                                                       15:11:46
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0030  0006  REM $TITLE:'Reagent Jet Printer  $SUBTITLE:'Pattern Filing'
0030  0006  'MODULE   - 'PATFILE' File Handling for patterns
0030  0006  '
0030  0006  'AUTHOR   - N. A. Enevold
0030  0006  '
0030  0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030  0006  '
0030  0006  'REVISION - 1.0 07-12-86 NAE Creation of initial code
0030  0006  '
0030  0006  'SYSTEM   - This code can only be compiled by the BASCOM
0030  0006  '            COMPILER, it will not run under the INTERPRETER!!
0030  0006  '
0030  0006  'DESCRIPTION:
0030  0006  '       This module allow file handling for patterns.  When inv
                    oked, it displays
0030  0006  '       the current contents of the pattern directory in 4 colu
                    ens of 20 entries
0030  0006  '       each.  The pattern which is currently selected for prin
                    ting is marked by
0030  0006  '       an asterisk to the left of the pattern name.  After the
                     directory is listed
0030  0006  '       the user is presented with 5 menu choices.  The left an
                    d right arrows are
0030  0006  '       used to highlight menu items and the enter key is used
                    to invoke action.
0030  0006  '       The menu choices and their actions are:
0030  0006  '
0030  0006  '               DELETE - Remove a pattern file from the directo
                    ry
0030  0006  '               COPY -   Copy a pattern file to a new pattern n
                    ame, saving the old pattern
0030  0006  '               RENAME - Change the name of the pattern without
                     changing the pattern itself
0030  0006  '               SELECT - Selct a pattern for printing
0030  0006  '               EXIT -   Return to the main menu
0030  0006  '
0030  0006  'DATA DICTIONARY
0030  0006  '       TYPE%       Which type of valid key was pushed
0030  0006  '       MENU%       Which menu item is being pointer to (0-4)
0030  0006  '       DIFF%       Distance to move MENU% at left or right arro
                    w
0030  0006  '       FLAG%       Error type 0-4
0030  0006  '       POINTER%    Position of PATNAME$ in directory list
0030  0006  '       PATNUM%             Number of pattern names in directory
                     list
0030  0006  '       ELNUM%      Number of elements in a pattern file
0030  0006  '       TEMP%       Storage for integers during pattern copy
0030  0006  '       I%          Counter used during pattern copy
0030  0006  '       J%          Counter used during pattern copy
0030  0006  '       A$          Misc. input string
0030  0006  '       FUNCT$      Printed at bottom of screen during prompt fo
                    r pattern name
0030  0006  '       PATNAME$    Pattern name currently being worked on
0030  0006  '       SELNAME$    Pattern name currently selected for printing
```

```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0030    0006   '       FILE$       Filename of pattern data file
0030    0006   '       SFILE$      Filename for source pattern data file used d
uring copy
0030    0006   '       DFILE$      Filename for destination pattern data file u
sed during copy
0030    0006   '       NEWNAME$    New pattern name for COPY and RENAME
0030    0006   '       TEMP$       Pattern names are held here as the directory
 is being re-written
0030    0006   '       NEWFILE$    Destination filename used while copying patt
ern data files
0030    0006   '       MESSAGE$    A message printed at the bottom of the scree
n
0030    0006   '       MENU$(4,1) Array of strings containing the short and lo
ng menu names
0030    0006   '       ERRMSG$     Message printed when any error occurs
0030    0006   '       ERR$        Appended to ERRMSG$ to indicate nature of er
ror
0030    0006   '       TEMP        Storage of real variables while copying patt
ern data files
0030    0006   REM $PAGE
```



```
Offset  Data   Source Line          IBM Personal Computer BASIC Compiler V2.00

0030    0006   SUB PATTERN.FILE STATIC

0047    0006
0047    0006           GOSUB INITIALIZE
004D    0006           TYPE% = 0
0054    0008
0054    0008           WHILE TYPE% <> 3
005F    0008                   A$ = ""
0069    000C                   WHILE A$ = ""
0076    000C                           A$ = INKEY$
0082    000C                   WEND
0085    000C                   IF A$ = CHR$(0) + CHR$(75) THEN TYPE% = 1:
 'left arrow
00AA    000C                   IF A$ = CHR$(0) + CHR$(77) THEN TYPE% = 2:
 'right arrow
00CF    000C                   IF A$ = CHR$(13) THEN TYPE% = 3:
 '<cr> to execute selection
00E9    000C
00E9    000C                   ON TYPE% GOSUB T1, T2, T3
00F6    000C           WEND
00FC    000C
00FC    000C           EXIT SUB
0100    000C
0100    000C   REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  4
Pattern Piling                                                         07-09-86
                                                                       15:11:46
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0100   000C    '******** SUB-ROUTINES FOR THIS MODULE ********
 0100   000C
 0100   000C    T1:             'left arrow
 0105   000C            TYPE% = 0
 010C   000C            IF MENU% = 0 THEN RETURN
 011B   000E            DIFF% = -1
 0122   0010            GOSUB NEW.MENU
 0128   0010            RETURN
 012C   0010
 012C   0010    T2:             'right arrow
 0131   0010            TYPE% = 0
 0138   0010            IF MENU% = 4 THEN RETURN
 0147   0010            DIFF% = 1
 014E   0010            GOSUB NEW.MENU
 0154   0010            RETURN
 0158   0010
 0158   0010    T3:             '<cr>  (execute selected menu item)
 015D   0010            LOCATE 25,1:PRINT SPACE$(79);
 017A   0010            ON MENU% + 1 GOSUB T3A, T3B, T3C, T3D, T3E
 018F   0010            GOSUB MENU.ON
 0195   0010            RETURN
 0199   0010
 0199   0010    REM $PAGE
```

```
0197  0010  T3A:            delete pattern
019E  0010          TYPE% = 0
01A5  0010          FUNCT$ = "Delete"
01AF  0014          GOSUB GET.SOURCE
0135  0014          IF LEN(PATNAME$) = 0 THEN RETURN
01C7  0018          IF PATNAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
                  RETURN
01E7  001E          GOSUB SEARCH
01ED  001E          IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
0209  0020
0209  0020          MESSAGE$ = "Deleting " + PATNAME$ + "     Please Wait..
                    "
0220  0024          GOSUB MESSAGE.ON
0226  0024
0226  0024                  'rewrite directory deleting PATNAME$ as indicat
                  ed by POINTER%
0226  0024          KILL "PATDIR.OLD"
022D  0024          NAME "PATDIR.RJP" AS "PATDIR.OLD"
0237  0024          OPEN "PATDIR.OLD" FOR INPUT AS #1
0248  0024          OPEN "PATDIR.RJP" FOR OUTPUT AS #2
025A  0024
025A  0024          INPUT #1, PATNUM%
026C  0026          PATNUM% = PATNUM% - 1
0275  0026          WRITE #2,PATNUM%
0286  0026
0286  0026          IF PATNUM% = 0 THEN GOTO DIR.DONE
0295  0026          FOR I% = 1 TO PATNUM% + 1
02A4  0028                  INPUT #1,PATNAME$
02B6  0028                  IF I% <> POINTER% THEN PRINT #2,PATNAME$
02D3  002A          NEXT I%
02E5  002A
02E5  002A    DIR.DONE:
02EA  002A          CLOSE #1:CLOSE #2
02F8  002A
02F8  002A                  'renove data file
02F8  002A          FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                  "PAT.RJP"
031C  002E          KILL FILE$
0323  002E
0323  002E                  'renane reaining data files to naintain linked
                   list with directory
0323  002E          WHILE (PATNUM% + 1) > POINTER%
0333  002E                  SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
                  ER%+1))-1) + "PAT.RJP"
0359  0032                  DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
                  %))-1) + "PAT.RJP"
037D  0036                  NAME SFILE$ AS DFILE$
0387  0036                  POINTER% = POINTER% + 1
039C  0036          WEND
0393  0036
0393  0036          GOSUB MESSAGE.OFF
0399  0036          PATNAME$ = SELNAME$
03A3  0036          GOSUB T3DA
03A9  0036          GOSUB DISP.DIR
```

Reagent Jet Printer
Pattern Filing

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
03AF	00C6	RETURN
03B1	00C6	
03B3	00C6	REM $PAGE

```
Offset  Data   Source Line        IBM Personal Computer BASIC Compiler V2.00
 5
 0383   0036   TCB:    'copy pattern
 0386   0036           TYPE% = 0
 038F   0036           IF PATNUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
 038E   0036           FUNCT$ = "Copy"
10 03E5 0036           GOSUB GET.SOURCE
 03EB   0036           IF LEN(PATNAME$) = 0 THEN RETURN
 03F3   0036           GOSUB SEARCH
 0402   0036           IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 041F   0036
15 041F 0036           GOSUB GET.NEW.NAME
 0425   0036           IF LEN(NEWNAME$) = 0 THEN RETURN
 0437   003A           IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
                    ETURN
 0457   003A
20 0457 003A           MESSAGE$ = "Copying " + PATNAME$ + " to " + NEWNAME$ +
                    "    Please wait.."
 047C   003A           GOSUB MESSAGE.ON
 0482   003A
 0482   003A                   'add NEWNAME$ at end of directory
25 0482 003A           KILL "PATDIR.OLD"
 0489   003A           NAME "PATDIR.RJP" AS "PATDIR.OLD"
 0493   003A           OPEN "PATDIR.OLD" FOR INPUT AS #1
 04A4   003A           OPEN "PATDIR.RJP" FOR OUTPUT AS #2
 04B6   003A
30 04B6 003A           INPUT #1, PATNUM%
 04C8   003A           PATNUM% = PATNUM% + 1
 04D1   003A           WRITE #2,PATNUM%
 04E2   003A
 04E2   003A           FOR I% = 1 TO PATNUM% - 1
35 04F1 003C                   INPUT #1,TEMP$
 0503   0040                   PRINT #2,TEMP$
 0513   0040           NEXT I%
 0525   0040           PRINT #2,NEWNAME$
 0535   0040
40 0535 0040           CLOSE #1:CLOSE #2
 0543   0040
 0543   0040                   'create copy of pattern data file
 0543   0040           FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                    ".PAT.RJP"
45 0567 0040           NEWFILE$ = RIGHT$(STR$(PATNUM%),LEN(STR$(PATNUM%))-1) +
                    ".PAT.RJP"
 0588   0044
 0586   0044           OPEN FILE$ FOR INPUT AS #1
 059C   0044           OPEN NEWFILE$ FOR OUTPUT AS #2
50 05AE 0044
 05AE   0044           INPUT #1,ELNUM%
 05C0   0046           WRITE #2,ELNUM%
 05D1   0046
 05D1   0046           FOR I% = 1 TO 4
55 05D8 0046                   INPUT #1,TEMP
 05EA   004A                   WRITE #2,TEMP
 05FA   004A           NEXT I%
 060A   004A
 060A   004A           FOR I% = 1 TO ELNUM%
```

```
Offset  Data    Source Line        IBM Personal Computer BASIC Compiler V2.00

 0617   004C                  FOR JZ = 1 TO 6
 061E   004C                        INPUT #1,TEMPZ
 0630   004E                        WRITE #2,TEMPZ
 0641   004E                  NEXT JZ
 0651   0050            NEXT IZ
 0663   0050
 0663   0050            CLOSE #1:CLOSE #2
 0671   0050
 0671   0050            GOSUB MESSAGE.OFF
 0677   0050            GOSUB DISP.DIR
 067D   0050            RETURN
 0681   0050
 0681   0050    T3C:            'rename pattern
 0686   0050            TYPEZ = 0
 068D   0050            FUNCT$ = "Rename"
 0697   0050            GOSUB GET.SOURCE
 069D   0050            IF LEN(PATNAME$) = 0 THEN RETURN
 06AF   0050            GOSUB SEARCH
 06B5   0050            IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
 06D1   0050
 06D1   0050            GOSUB GET.NEW.NAME
 06D7   0050            IF LEN(NEWNAME$) = 0 THEN RETURN
 06E9   0050            IF LEN(NEWNAME$) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
                ETURN
 0709   0050            IF NEWNAME$ = PATNAME$ THEN RETURN
 071C   0050
 071C   0050            MESSAGE$ = "Renaming " + PATNAME$ + " to " + NEWNAME$ +
                 "    Please wait.."
 0741   0050            GOSUB MESSAGE.ON
 0747   0050
 0747   0050                    'change pattern name in directory replacing PAT
               NAME$ with NEWNAME$
 0747   0050            KILL "PATDIR.OLD"
 074E   0050            NAME "PATDIR.RJP" AS "PATDIR.OLD"
 0756   0050            OPEN "PATDIR.OLD" FOR INPUT AS #1
 0769   0050            OPEN "PATDIR.RJP" FOR OUTPUT AS #2
 077B   0050
 077B   0050            INPUT #1, PATNUMZ
 078D   0050            WRITE #2,PATNUMZ
 079E   0050
 079E   0050            FOR IZ = 1 TO PATNUMZ
 07A8   0052                  INPUT #1,TEMP$
 07BD   0052                  IF IZ <> POINTERZ THEN PRINT #2,TEMP$
 07DA   0052                  IF IZ = POINTERZ THEN PRINT #2,NEWNAME$
 07F7   0052            NEXT IZ
 0809   0052
 0809   0052            CLOSE #1:CLOSE #2
 0817   0052
 0817   0052            GOSUB MESSAGE.OFF
 081D   0052
 081D   0052                  'select new pattern name if necessary
 081D   0052            IF PATNAME$ = SELNAME$ THEN PATNAME$ = NEWNAME$:GOSUB T
                3DA
 083C   0052            GOSUB DISP.DIR
```

```
Reagent Jet Printer                                                    PAGE  9
Pattern Filing                                                         07-09-86
                                                                       15:11:46
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0842   0052            RETURN
 0846   0052
 0846   0052    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE 10
Pattern Filing                                                         07-09-86
                                                                       15:11:46
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0846   0052    T3D:            'select pattern for printing
 084B   0052            TYPE% = 0
 0852   0052            FUNCT$ = "Select"
 085C   0052            GOSUB GET.SOURCE
 0862   0052            IF LEN(PATNAME$) = 0 THEN RETURN
 0874   0052            IF PATNAME$ = SELNAME$ THEN RETURN
 0887   0052            GOSUB T3DA
 088D   0052            GOSUB DISP.DIR
 0893   0052            RETURN
 0897   0052
 0897   0052    T3DA:
 089C   0052            GOSUB SEARCH
 08A2   0052            IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
 08BE   0052
 08BE   0052            MESSAGE$ = "Selecting " + PATNAME$ + "     Please Wait.
                ..."
 08D5   0052            GOSUB MESSAGE.ON
 08DB   0052
 08DB   0052                    'change entrys in pattern default file PATDEF.R
                JP
 08DB   0052            OPEN "PATDEF.RJP" FOR OUTPUT AS #1
 08ED   0052            FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
                "PAT.RJP"
 0911   0052
 0911   0052            PRINT #1,FILE$
 0921   0052            PRINT #1,PATNAME$
 0931   0052
 0931   0052            CLOSE #1
 0938   0052            GOSUB MESSAGE.OFF
 093E   0052            RETURN
 0942   0052
 0942   0052    T3E:    'exit pattern filing
 0947   0052            RETURN
 0948   0052
 0948   0052    REM $PAGE
```

```
Reagent Jet Printer
Pattern Filing                                                    PAGE  11
                                                                  07-09-86
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00  15:11:46

0948    0052    SEARCH:
0950    0052            POINTER% = 0
0957    0052            OPEN "PATDIR.RJP" FOR INPUT AS #1
0968    0052            INPUT #1,PATNUM%:       get number of patterns in direc
                tory
097A    0052            IF PATNUM% = 0 THEN CLOSE #1:RETURN
0990    0052            TEMP$ = ""
099A    0052            WHILE (POINTER% < PATNUM%) AND (PATNAME$ <> TEMP$)
09C2    0052                    LINE INPUT #1,TEMP$
09CF    0052                    POINTER% = POINTER% + 1
09D8    0052            WEND
09DB    0052            IF PATNAME$ <> TEMP$ THEN POINTER% = 0
09F1    0052            CLOSE #1
09FB    0052            RETURN
09FC    0052
09FC    0052    GET.SOURCE:
0A01    0052            LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to "FU
                NCT$"  ";
0A33    0052            LINE INPUT;"",PATNAME$
0A41    0052            LOCATE 25,1:PRINT SPACE$(79);
0A5E    0052            RETURN
0A62    0052
0A62    0052    GET.NEW.NAME:
0A67    0052            LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
0A8D    0052            LINE INPUT;"",NEWNAME$
0A9B    0052            LOCATE 25,1:PRINT SPACE$(79);
0AB8    0052            RETURN
0ABC    0052
0ABC    0052    DISP.DIR:       'display directory in 4 columns, 20 rows
0AC1    0052                    'read default pattern name into SELNAME$
0AC1    0052            OPEN "PATDEF.RJP" FOR INPUT AS #1
0AD2    0052            INPUT #1,SELNAME$:      'discard data file name
0AE4    0052            INPUT #1,SELNAME$
0AF6    0052            CLOSE #1
0AFD    0052
0AFD    0052            OPEN "PATDIR.RJP" FOR INPUT AS #1
0B0E    0052            INPUT #1,PATNUM%:       read number of patterns
0B20    0052
0B20    0052            MESSAGE$ = "Reading Pattern Directory  Please Wait"
0B2A    0052            GOSUB MESSAGE.ON
0B30    0052            FLAG% = 0
0B37    0052            TEMP% = PATNUM% - 1:IF PATNUM% < 80 THEN TEMP% = PATNUM
                %
0B52    0052            FOR I% = 0 TO TEMP%
0B5E    0054                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+1
0B91    0054                    PRINT SPACE$(18);
0BA1    0054            NEXT I%
0BB3    0054
0BB3    0054            FOR I% = 0 TO PATNUM% - 1
0BC1    0056                    INPUT #1,PATNAME$
0BD3    0056                    LOCATE (I% MOD 20)+1,(INT(I%/20)*20)+3
0C06    0056                    PRINT PATNAME$;
0C13    0056                    IF PATNAME$ = SELNAME$ THEN LOCATE (I% MOD 20)+
                1,(INT(I%/20)*20)+1:PRINT "*";
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
0C62  0056          NEXT I%
0C77  0056          CLOSE #1
0C7E  0056          GOSUB MESSAGE.OFF
0C84  0056          RETURN
0C86  0056
0C8E  0056    INITIALIZE:
0C8D  0056          DIM MENU$(4,1)
0C8E  007E          MENU$(0,0) = "Delete"
0CA6  007E          MENU$(0,1) = "Remove a pattern file from the directory"
0CC1  007E          MENU$(1,0) = "Copy"
0CDC  007E          MENU$(1,1) = "Copy a pattern file to a new pattern name
                    "
0CF5  007E          MENU$(2,0) = "Rename"
0D12  007E          MENU$(2,1) = "Rename a pattern file in the directory"
0D30  007E          MENU$(3,0) = "Select"
0D4B  007E          MENU$(3,1) = "Select a pattern file to be printed"
0D67  007E          MENU$(4,0) = "Exit"
0D82  007E          MENU$(4,1) = "Return to the main menu"
0D9E  007E
0D9E  007E          COLOR 9,0:CLS
0DB1  007E          LOCATE 21,1
0DBE  007E          FOR I% = 1 TO 80
0DC5  007E                PRINT "D";
0DD2  007E          NEXT I%
0DE2  007E
0DE2  007E          FOR MENU% = 0 TO 4
0DEB  007E                GOSUB MENU.OFF
0DEE  007E          NEXT MENU%
0DFE  007E
0DFE  007E          GOSUB DISP.DIR
0E04  007E          IF FLAG% > 0 THEN GOSUB SHOW.ERROR
0E15  007E          MENU% = 4
0E1C  007E          GOSUB MENU.ON
0E22  007E
0E22  007E          RETURN
0E26  007E
0E26  007E    NEW.MENU:
0E2B  007E          GOSUB MENU.OFF
0E31  007E          MENU% = MENU% + DIFF%
0E3D  007E          GOSUB MENU.ON
0E43  007E          RETURN
0E47  007E
0E47  007E    MENU.ON:
0E4C  007E          LOCATE 22,(MENU%*10)+18
0E63  007E          COLOR 0,7
0E6F  007E          PRINT MENU$(MENU%,0);
0E8D  007E          LOCATE 23,40-LEN(MENU$(MENU%,1))/2
0EC1  007E          COLOR 7,0
0ECD  007E          PRINT MENU$(MENU%,1);
0EEC  007E          RETURN
0EF0  007E
0EF0  007E    MENU.OFF:
0EF5  007E          LOCATE 22,(MENU%*10)+18
0F0C  007E          COLOR 14,0
```

```
Reagent Jet Printer
Pattern Filing                                                    PAGE  13
                                                                  07-09-86
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00  15:11:46

 0F18   007E            PRINT MENU$(MENUZ,0);
 0F36   007E            LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
 0F6A   007E            PRINT SPACE$(LEN(MENU$(MENUZ,1)));
 0F8F   007E            RETURN
 0F93   007E
 0F93   007E    SHOW.ERROR:
 0F98   007E            ON FLAGZ GOSUB ER1, ER2, ER3, ER4
 0FA9   007E            ERRMSG$ = ERR$ + "     Strike any key.."
 0FB9   0086            LOCATE 24,40-LEN(ERRMSG$)/2
 0FDB   0086            COLOR 13,0
 0FE7   0086            PRINT ERRMSG$;
 0FF4   0086            A$ = ""
 0FFE   0086            WHILE A$ = ""
 100D   0086                 A$ = INKEY$
 1017   0086            WEND
 101A   0086            GOSUB MESSAGE.OFF
 1020   0086            RETURN
 1024   0086
 1024   0086    ER1:
 1029   0086            ERR$ = PATNAME$ + " Not Found in the Directory"
 1039   0086            RETURN
 103D   0086
 103D   0086    ER2:
 1042   0086            ERR$ = "Pattern Name is too Long (15 characters max.)"
 104C   0086            RETURN
 1050   0086
 1050   0086    ER3:
 1055   0086            ERR$ = "Directory is Full (80 patterns max.)"
 105F   0086            RETURN
 1063   0086
 1063   0086    ER4:
 1068   0086            ERR$ = "Cannot Modify SELECTd pattern Name"
 1072   0086            RETURN
 1076   0086
 1076   0086    MESSAGE.ON:
 1078   0086            LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
                GE$;
 1086   0086            RETURN
 108A   0086
 108A   0086
 108A   0086    MESSAGE.OFF:
 108F   0086            LOCATE 24,1:COLOR 15,0:PRINT SPACE$(79);
 10EB   0086            RETURN
 10EC   0086
 10EC   0086    END SUB
 10F3   0086
 1668   0086

50426 Bytes Available
45670 Bytes Free

    0 Warning Error(s)
    0 Severe  Error(s)
```

```
Reagent Jet Printer                                                    PAGE  1
Main Line Code                                                         07-09-86
                                                                       15:27:04
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00
 0030   0006    REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Main Line Code'
 0030   0006
 0030   0006    'MODULE   - "MAIN"
 0030   0006
 0030   0006    'AUTHOR   - N. A. Enevold
 0030   0006
 0030   0006    'COPYRIGHT (C) 1986 ABBOTT LABORATORIES
 0030   0006
 0030   0006    'REVISION - 1.1 02-19-86 NAE Add notes and revise TYPE% resetin
                g
 0030   0006    '         - 1.0 02-14-86 NAE Creation of initial code
 0030   0006
 0030   0006    'SYSTEM   - This code can only be compiled by the BASCOM
 0030   0006    '           COMPILER, it will not run under the INTERPRETER!!
 0030   0006
 0030   0006    'DESCRIPTION
 0030   0006    '       This is the main controlling module for the Reagent Jet
                 Printer.
 0030   0006    '       It displays a menu in table form that allows 6 function
                s to be
 0030   0006    '       selected.  PATTERN DEFINITION allows the user to define
                 patterns
 0030   0006    '       to be printed.  PATTERN FILING lets the user delete, co
                py, rename
 0030   0006    '       and select patterns for printing.  REAGENT CALIBRATION
                permits setting
 0030   0006    '       of operation parameters for different reagents.  REAGEN
                T FILING is
 0030   0006    '       the same as pattern filing.  PRINTING PRINT prints the
                selected
 0030   0006    '       pattern with the selected reagent.  SYSTEM EXIT TO DOS
                ends the session.
 0030   0006    '       Using up and down arrow keys let the user move through
                the menu and
 0030   0006    '       the Enter (cr) key activates the selection.
 0030   0006
 0030   0006    'DATA DICTIONARY
 0030   0006    '       MENU%           This value represents the current menu
                item (0-5)
 0030   0006    '       MENU$(5,1)      String array for displaying menu items.
                  6 rows by 2 columns
 0030   0006    '                       Each row corresponds to a menu item (0-
                5)
 0030   0006    '                       First column is short menu name in high
                lighted area
 0030   0006    '                       Second column is long description displ
                ayed at menu bottom
 0030   0006    '       MROW%(5)        This array stores to row in which the s
                hort menu name will be displayed
 0030   0006    '       DIFF%           This value is used it change MENU% in r
                esponse to arrow keys
 0030   0006    '       TYPE%           This value is set based on which valid
                key is pressed
 0030   0006    '                       0 = No valid key.  1 = Up Arrow.  2 = D
```

```
Reagent Jet Printer
Main Line Code                                                    PAGE   2
                                                                  07-09-86
Offset  Data    Source Line                 IBM Personal Computer BASIC Compiler V2.00  15:27:04

                own Arrow.  3 = (cr).
0030    0006            TEMP%               Used to store MENU% while screen is ref
reshed
0030    0006            A$
0030    0006            C$                  Used to store single input keystrokes
                        Used to store special graphics characte
rs used in drawing the menu table
0030    0006            I%                  Counter used to refresh display
0030    0006            R%                  Row in which special graphics character
is disolayed
0030    0006            C%                  Column in which special graphics charac
ter is displayed
0030    0006    REM $PAGE


Reagent Jet Printer
Main Line Code                                                    PAGE   3
                                                                  07-09-86
Offset  Data    Source Line                 IBM Personal Computer BASIC Compiler V2.00  15:27:04

0030    0006
0030    0006    'Main-line code for RJP Reagent Jet Printer
0030    0006
0030    0006    MAIN.LINE.CODE:
0030    0006
0030    0006            GOSUB INITIALIZE
0043    0006
0046    0006            WHILE TYPE% <> 3
0056    0008
0056    0008                    TYPE% = 0
005D    0008                    A$ = ""
0067    000C                    WHILE A$ = ""
0076    000C                            A$ = INKEY$
0080    000C                    WEND
0083    000C
0083    000C                    IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 1:'
                up arrow
00A8    000C                    IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 2:'
                down arrow
00CD    000C                    IF A$ = CHR$(13) THEN TYPE% = 3:'
                (cr) execute command
00E7    000C
00E7    000C                    ON TYPE% GOSUB T1, T2, T3
00F6    000C
00F6    000C            WEND
00FA    000C
00FA    000C            CLS
0101    000C            COLOR 7,0,0
0112    000C            SYSTEM
0116    000C
0116    000C    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0116   000C    '******** SUB-ROUTINES FOR MAIN PROGRAM
 0116   000C    T1:     'up arrow
 0118   000C            IF MENU% = 0 THEN RETURN
 012A   000E            DIFF% = -1
 0131   0010            GOSUB NEW.MENU
 0137   0010            RETURN
 013B   0010
 013B   0010    T2:     'down arrow
 0140   0010            IF MENU% = 5 THEN RETURN
 014F   0010            DIFF% = 1
 0156   0010            GOSUB NEW.MENU
 015C   0010            RETURN
 0160   0010
 0160   0010    T3:
 0165   0010            ON MENU% + 1 GOSUB T31, T32, T33, T34, T35, T36
 017C   0010            IF MENU% < 5 THEN TYPE% = 0:'   reset TYPE% so progra
                    won't end
 018E   0010            SCREEN 0,0,3,3
 01A5   0010            RETURN
 01A9   0010
 01A9   0010    T31:    'pattern definition
 01AE   0010            CALL PATENTRY:          'in module PATENT
 01BA   0010            GOSUB REFRESH
 01C0   0010            RETURN
 01C4   0010
 01C4   0010    T32:    'pattern filing
 01C9   0010            SCREEN 0,0,0,0:CLS
 01E5   0010            CALL PATTERN.FILE:      'in module PATFILE
 01F1   0010            RETURN
 01F5   0010
 01F5   0010    T33:    'reagent calibration
 01FA   0010            CALL REAGENT.CALIBRATE: 'in module REACAL
 0206   0010            RETURN
 020A   0010
 020A   0010    T34:    'reagent filing menu
 020F   0010            SCREEN 0,0,0,0:CLS
 022B   0010            CALL REAGENT.FILE:      'in module REAFILE
 0237   0010            RETURN
 023B   0010
 023B   0010    T35:    'print pattern
 0240   0010            CALL PATPRINT:          'in module PATPRINT
 024C   0010            RETURN
 0250   0010
 0250   0010    T36:    'exit system, don't reset TYPE%
 0255   0010            RETURN
 0259   0010
 0259   0010    REM $PAGE
```

```
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

0259    0010    NEW.MENU:
025E    0010            GOSUB MENU.OFF
0264    0010            MENU% = MENU% + DIFF%
0270    0010            GOSUB MENU.ON
0276    0010            RETURN
027A    0010
027A    0010    INITIALIZE:
027F    0010            CALL POI.INIT
0288    0010
0288    0010            define and initialize arrays
0288    0010            DIM MROW%(5)
028C    001C            MROW%(0) = 4
029E    001C            MROW%(1) = 6
02B1    001C            MROW%(2) = 10
02C4    001C            MROW%(3) = 12
02D7    001C            MROW%(4) = 16
02EA    001C            MROW%(5) = 20
02FD    001C
02FD    001C            DIM MENUS(5,1)
02FE    004C            RESTORE MENU.STRING.DATA
0305    004C            FOR I% = 0 TO 5
030B    004C                    READ MENUS(I%,0),MENUS(I%,1)
033B    004E            NEXT I%
034B    004E
034B    004E            set initial values into variables
034B    004E            TYPE% = 0
0352    004E            MENU% = 0
0359    004E
0359    004E    REFRESH: redraw screen and highlight current menu selection
035E    004E
035E    004E            SCREEN 0,0,0,0:CLS:COLOR 7,0,0
0388    004E            LOCATE 10,32:PRINT "Loading Menu....."
03A5    004E            SCREEN 0,0,3,0:CLS
03C2    004E
03C2    004E
03C2    004E            COLOR 13,0
03CE    004E            LOCATE 1,3:
03DB    004E            PRINT "REAGENT JET PRINTER";
03EB    004E            COLOR 10,0
03F4    004E            LOCATE 5,26
0401    004E            PRINT "PATTERN"
040E    004E            LOCATE 11,26
041B    004E            PRINT "REAGENT"
0428    004E            LOCATE 16,26
0435    004E            PRINT "PRINTING"
0442    004E            LOCATE 20,27
044F    004E            PRINT "SYSTEM"
045C    004E
045C    004E            draw the menu table in special graphics characters
045C    004E            COLOR 9,0
0466    004E            FOR I% = 18 TO 63
046F    004E                    LOCATE 2,I%:PRINT "D";
048A    004E                    LOCATE 8,I%:PRINT "D";
04A5    004E                    LOCATE 14,I%:PRINT "D";
```

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```
04C0  004E                LOCATE 19,I%:PRINT "O";
04D8  004E                LOCATE 22,I%:PRINT "O";
04F6  004E                LOCATE 24,I%:PRINT "O";
0511  004E            NEXT I%
0524  004E            FOR I% = 3 TO 23
052B  004E                LOCATE I%,17:PRINT "I";
0546  004E                LOCATE I%,64:PRINT "I";
0561  004E            NEXT I%
0571  004E            RESTORE TABLE
0578  004E            FOR I% = 1 TO 12
057F  004E                READ R%,C%,C$
0592  0056                LOCATE R%,C%:PRINT C$;
05AE  0056            NEXT I%
05BE  0056
05BE  0056            'print the instructions
05BE  0056            COLOR 7,0
05CA  0056            LOCATE 25,6
05D7  0056            PRINT "Use   or   to highlight menu items.  Use     to
                    activate selection.";
05E4  0056
05E4  0056            COLOR 15,0
";
060A  0056            LOCATE 25,15:PRINT "";
0624  0056            LOCATE 25,47:PRINT "DY";
063E  0056
063E  0056            'display the 6 menu choices
063E  0056            TEMP% = MENU%
0645  0058            FOR MENU% = 0 TO 5
064B  0058                GOSUB MENU.OFF
0651  0058            NEXT MENU%
0661  0058            MENU% = TEMP%
0668  0058
0668  0058            'highlight the currently active menu item
0668  0058            GOSUB MENU.ON
066E  0058
066E  0058            SCREEN 0,0,3,3
0685  0058            RETURN
0689  0058
0689  0058    MENU.ON:'highlight the menu MENU% and display its long descript
                    ion
066E  0058            COLOR 0,7
069A  0058            LOCATE MROW%(MENU%),52-LEN(MENU$(MENU%,0))/2
06DA  0058            PRINT MENU$(MENU%,0);
06F6  0058            COLOR 7,0
0704  0058            LOCATE 23,40.5-LEN(MENU$(MENU%,1))/2
0733  0058            PRINT MENU$(MENU%,1);
0757  0058            RETURN
075B  0058
075B  0058    MENU.OFF:'un-highlight menu MENU% and erase long description
0760  0058            COLOR 14,0
076C  0058            LOCATE MROW%(MENU%),52-LEN(MENU$(MENU%,0))/2
07AC  0058            PRINT MENU$(MENU%,0);
07CA  0058            COLOR 7,0
07D6  0058            LOCATE 23,40.5-LEN(MENU$(MENU%,1))/2
```

Reagent Jet Printer
Main Line Code

IBM Personal Computer BASIC Compiler V2.00

```
Offset  Data    Source Line
 082A   0058            PRINT SPACE$(LEN(MENU$(MENUZ,I)));
 082F   0058            RETURN
 0833   0058
 0833   0058    REM $PAGE
```

```
Reagent Jet Printer                                                    PAGE  8
Main Line Code                                                         07-07-86
                                                                       15:27:04
Offset  Data    Source Line          IBM Personal Computer BASIC Compiler V2.00

 0833   0058   '******** DATA FIELDS USED BY THE MAIN PROGRAM ********
 0833   0058
 0833   0058   MENU.STRING.DATA:       'first entry is menu name, second is lo
                ng description
 0838   0058
 0838   0058           DATA "DEFINITION", "Create and Modify Patterns"
 083A   0058           DATA "FILING",     "Delete, Copy, Rename, and Select Pa
                tterns"
 083C   0058           DATA "CALIBRATION","Calibrate and Modify Reagent Profil
                es"
 083E   0058           DATA "FILING",     "Delete, Copy, Rename, and Select Re
                agents"
 0840   0058           DATA "PRINT",      "Print Selected Pattern with Selecte
                d Reagent"
 0842   0058           DATA "EXIT TO DOS","Leave Program and Return to DOS"
 0844   0058
 0844   0058   TABLE:  'first entry is row, second is column, third is special
                 graphics character
 0849   0058
 0849   0058           DATA 2,17,"2"
 084B   0058           DATA 2,64,"7"
 084D   0058           DATA 8,17,"C"
 084F   0058           DATA 8,64,"4"
 0851   0058           DATA 14,17,"C"
 0853   0058           DATA 14,64,"4"
 0855   0058           DATA 18,17,"C"
 0857   0058           DATA 18,64,"4"
 0859   0058           DATA 22,17,"C"
 085B   0058           DATA 22,64,"4"
 085D   0058           DATA 24,17,"8"
 085F   0058           DATA 24,64,"7"
 0861   0058
 0861   0058           END
 0865   0058
 0B42   0058

50476 Bytes Available
47680 Bytes Free

     0 Warning Error(s)
     0 Severe  Error(s)
```

Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:

a jetting chamber defining a volume and comprising a first and second aperture, the first aperture adapted to receive diagnostic fluid, the second aperture defining an orifice;

a transducer in mechanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the jetting chamber in response to a selected electrical pulse and

thereby cause the jetting chamber to omit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and

means for generating a numb r of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

2. The invention of Claim 1 wherein the system further comprises:

at least one additional jetting chamb r in fluid communication with an additional diagnostic fluid;

at least one additional transducer in mechanical communication with the additional jetting chamber;

at least one additional means for applying an electrical pulse to the additional transducer;

means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the diagnostic fluids to be dispensed in a desired volumetric ratio; and

a receptacle adapted for and positioned to receive the fluids.

3. The invention of Claim 1 wherein the system further comprises:

means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted addi-tional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a predefined dispensing order.

4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix with the serum.

5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the trans-ducer is mounted concentrically about the cylindrical tube.

6. The invention of Claim 1 wherein the jetting chamber is conically shaped.

7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is integrally formed with the transducer.

8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transduc r.

9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer is disc shaped and forms the base of the conically shaped jetting chamber.

10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with a hydrophobic polymer.

11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from the first electrode.

12. The invention of Claim 1 wherein the means for generating produces an electrical pulse of selected rise anc fall time constants and of selected duration. voltage and polarity.

13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for scaling the voltage of the pulse in response to a selectable digital value.

14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted diagnostic fluid along a desired path.

15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:

(a) generating an electrical pulse of predefined characteristics;

(b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in response to the electrical pulse such tha: a droplet of fluid of known volume is propelled through an orifice in the chamber; and

(c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed.

FIG. 1

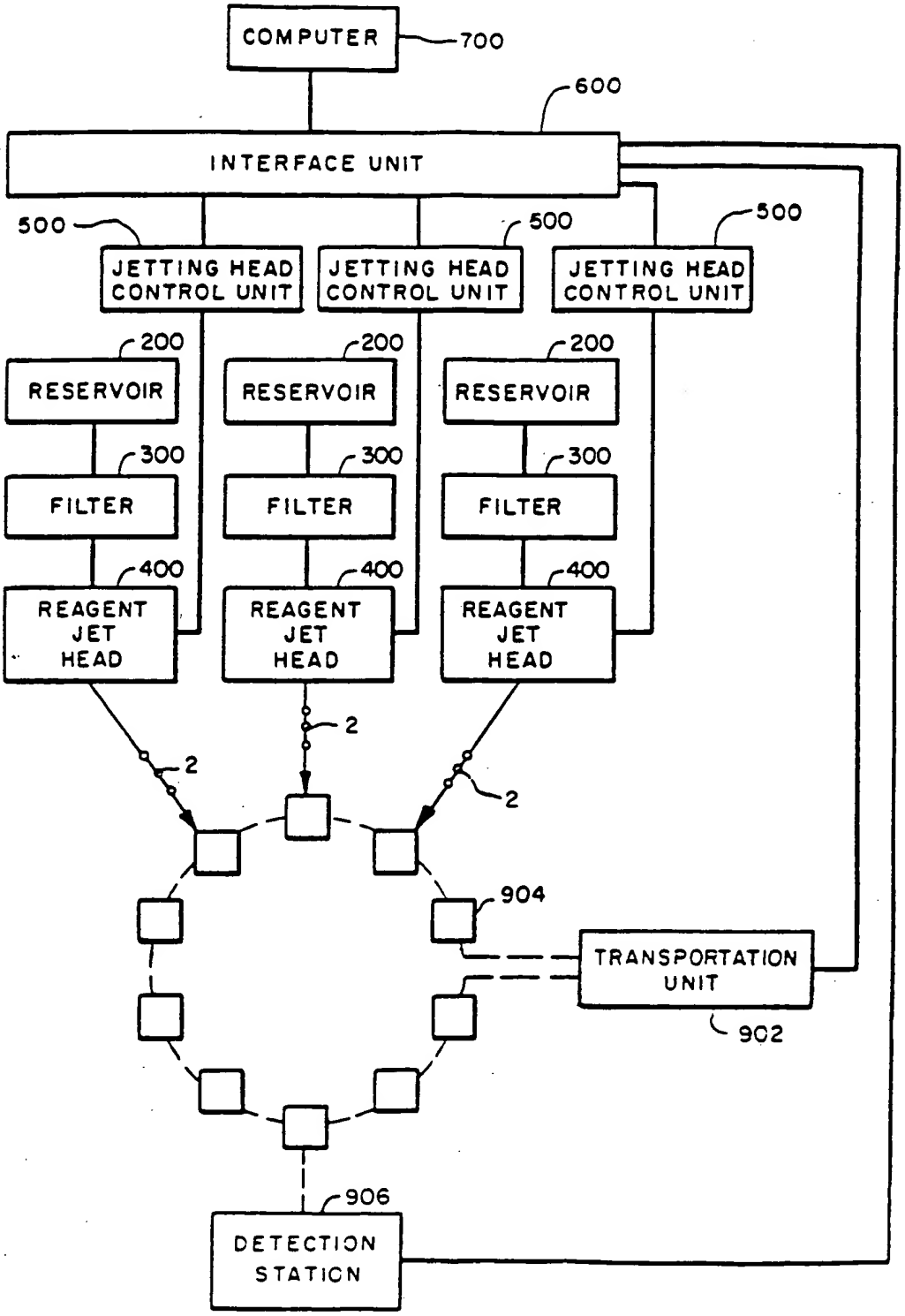

COMPUTER
700
600
INTERFACE UNIT
500
500
500
JETTING HEAD CONTROL UNIT
JETTING HEAD CONTROL UNIT
JETTING HEAD CONTROL UNIT
200
200
200
RESERVOIR
RESERVOIR
RESERVOIR
300
300
300
FILTER
FILTER
FILTER
400
400
400
REAGENT JET HEAD
REAGENT JET HEAD
REAGENT JET HEAD
2
2
2
904
TRANSPORTATION UNIT
902
906
DETECTION STATION

FIG. 2a

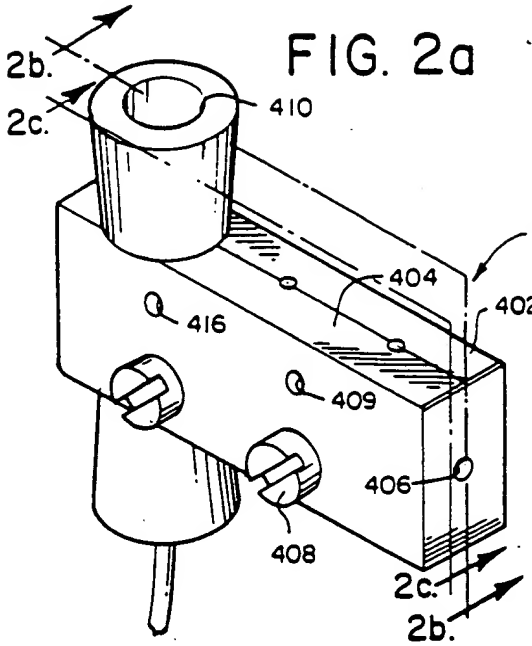


FIG. 2b

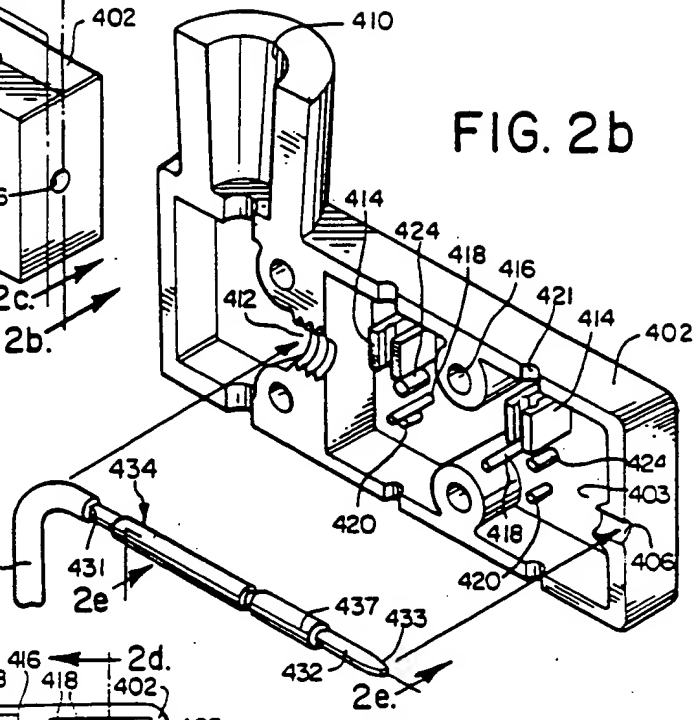
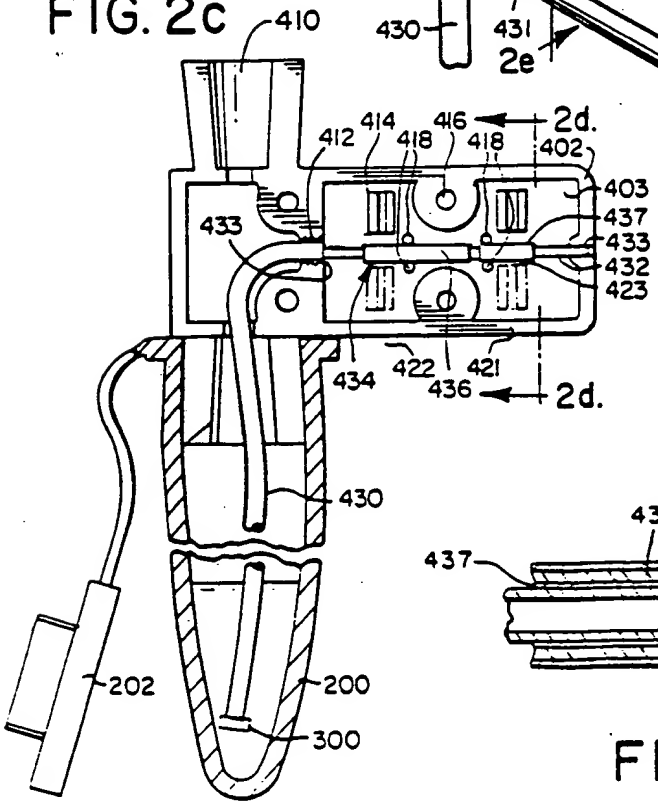


FIG. 2c



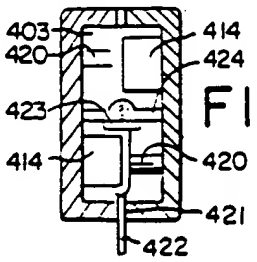


FIG. 2d

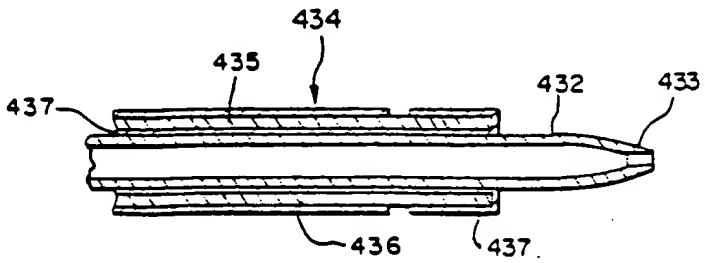
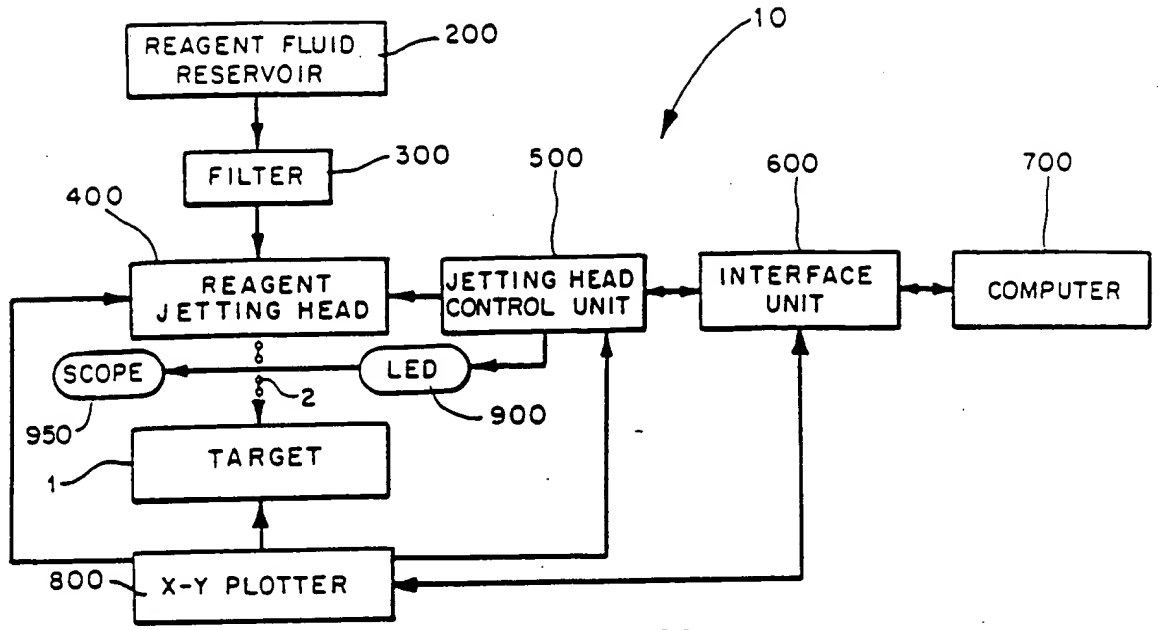


FIG. 2e

FIG. 3


10
REAGENT FLUID RESERVOIR
200
FILTER
300
500
600
700
400
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
SCOPE
LED
2
950
900
TARGET
1
800
X-Y PLOTTER

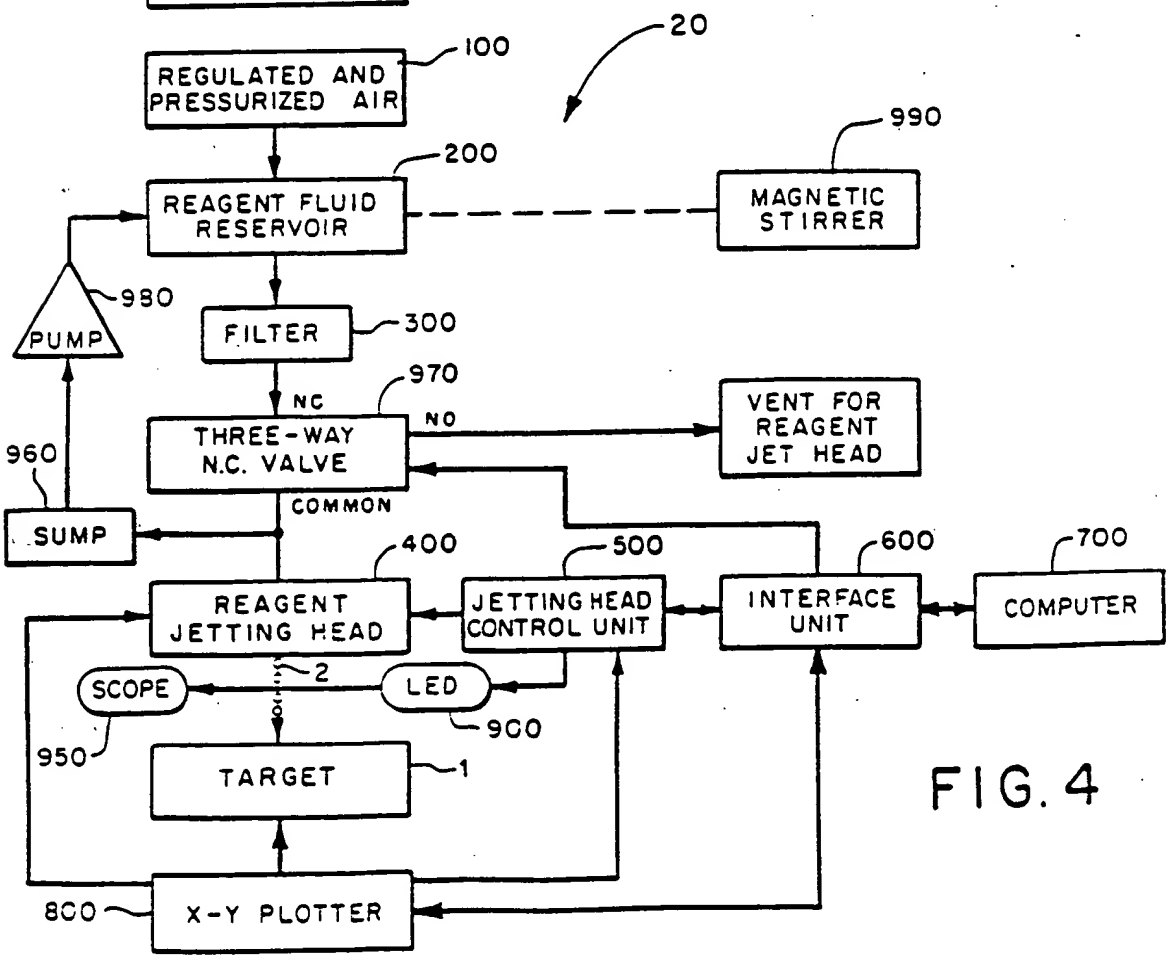

20
REGULATED AND PRESSURIZED AIR
100
990
200
REAGENT FLUID RESERVOIR
MAGNETIC STIRRER
980
PUMP
FILTER
300
970
NC
NO
THREE-WAY N.C. VALVE
VENT FOR REAGENT JET HEAD
960
COMMON
SUMP
400
500
600
700
REAGENT JETTING HEAD
JETTING HEAD CONTROL UNIT
INTERFACE UNIT
COMPUTER
2
SCOPE
LED
950
900
TARGET
1
800
X-Y PLOTTER

FIG. 4

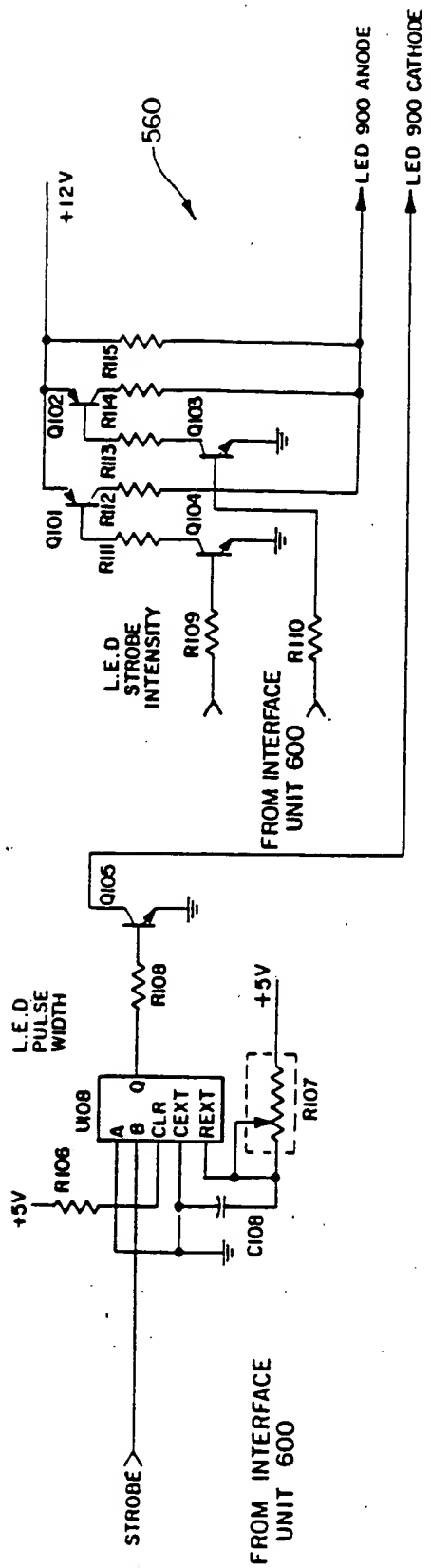

560
+12V
LED 900 ANODE
LED 900 CATHODE
Q101
Q102
Q103
Q104
Q105
R111
R112
R113
R114
R115
R109
R110
L.E.D STROBE INTENSITY
FROM INTERFACE UNIT 600
L.E.D PULSE WIDTH
U108
A
B
Q
CLR
CEXT
REXT
R106
R107
R108
C108
+5V
STROBE
FROM INTERFACE UNIT 600

FIG. 5a

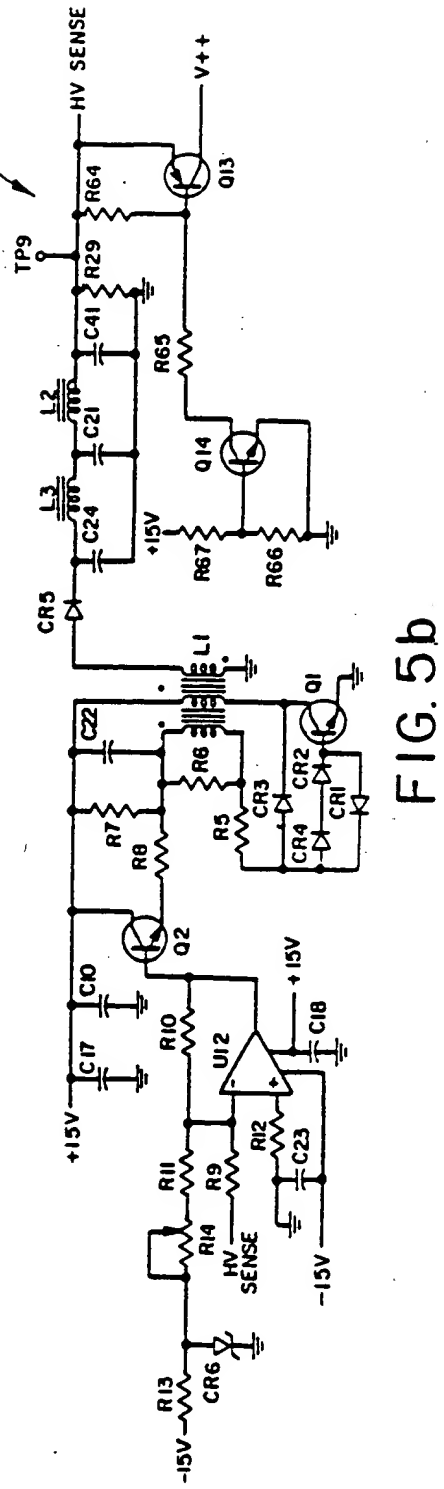

540
HV SENSE
V++
TP9
R64
R29
R65
Q13
Q14
C41
C21
C24
L2
L3
+15V
R67
R66
CR5
L1
Q1
C22
R6
R7
R8
R5
CR3
CR2
CR4
CR1
Q2
C10
C17
R10
U12
C18
R11
R9
R12
C23
R14
HV SENSE
-15V
R13
CR6

FIG. 5b

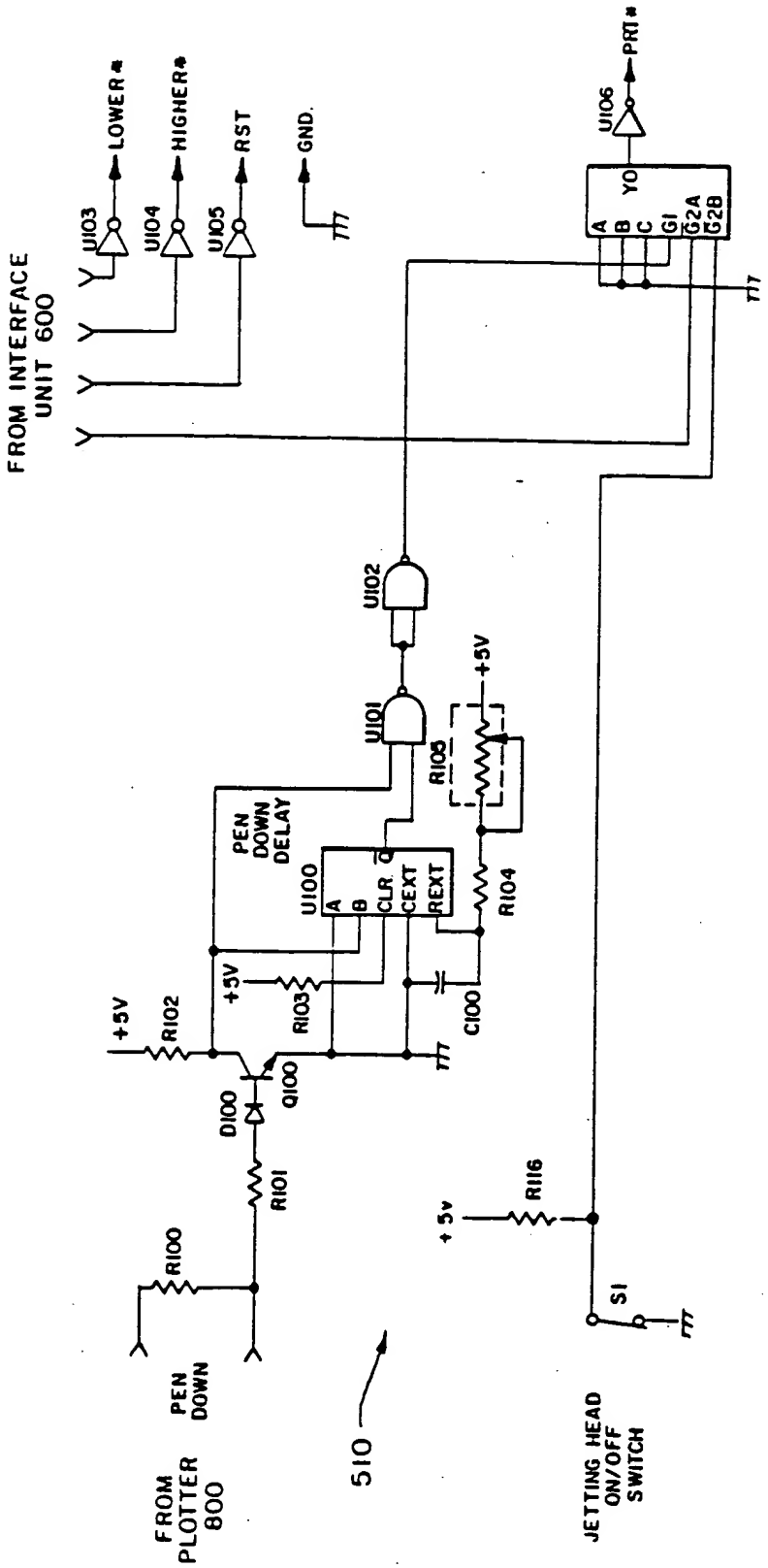

FROM INTERFACE UNIT 600
U103
U104
U105
LOWER*
HIGHER*
RST
GND.
U106
PRT*
A
B
C
G1
G2A
G2B
Y0
U102
U101
+5V
R105
PEN DOWN DELAY
U100
CLR
CEXT
REXT
R104
R103
C100
R102
Q100
D100
R101
R100
R116
S1
PEN DOWN
FROM PLOTTER 800
510
JETTING HEAD ON/OFF SWITCH

FIG. 5c

FIG. 5d

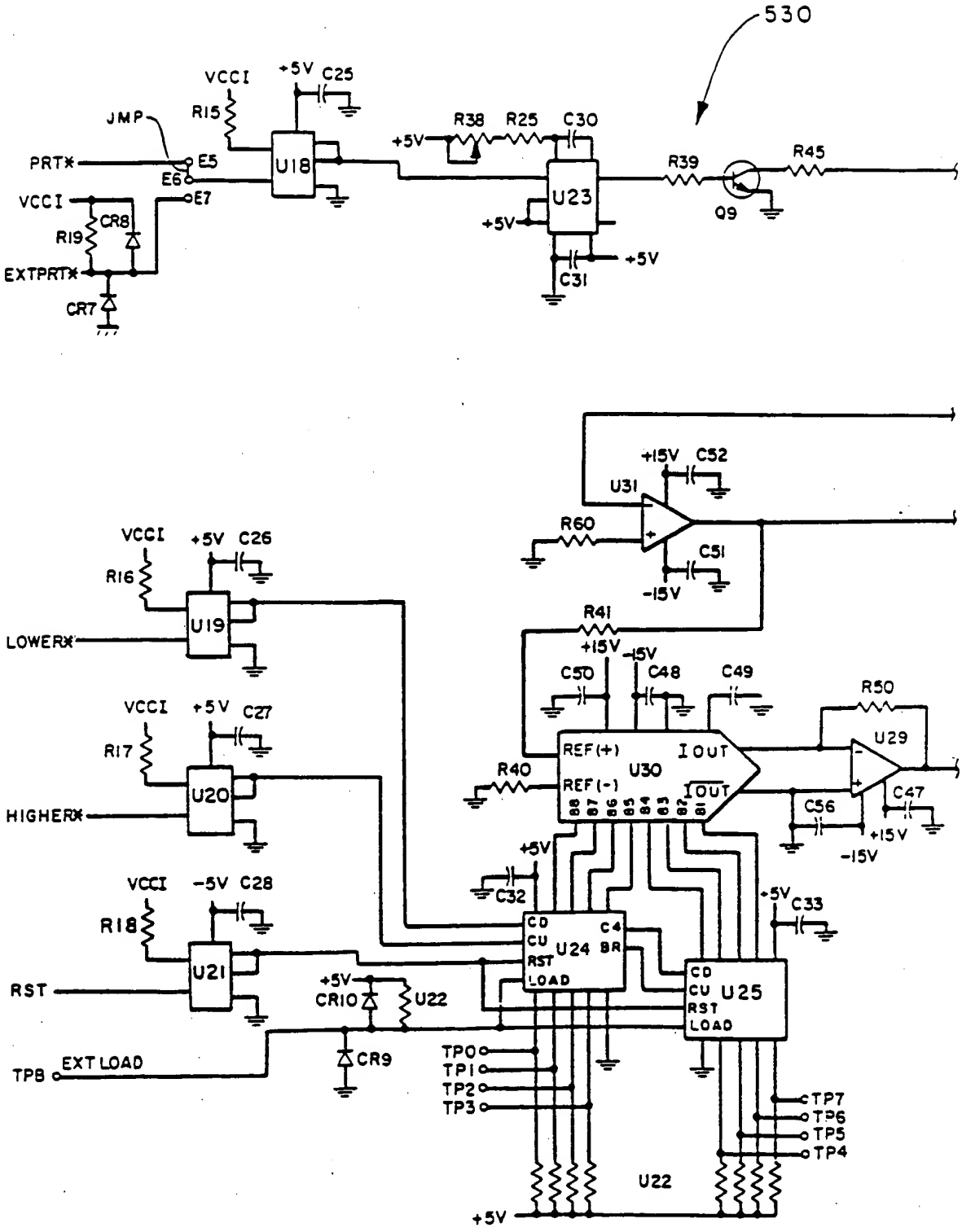

530
VCCI
+5V C25
R15
JMP
PRT*
E5
E6
E7
U18
VCCI
CR8
R19
EXTPRT*
CR7
+5V
R38 R25 C30
U23
+5V
C31
+5V
R39
Q9
R45
+15V C52
U31
R60
C51
-15V
R41
+15V
-15V
C50
C48
C49
R50
U29
REF(+)
REF(-)
U30
IOUT
IOUT
R40
C56
C47
+15V
-15V
VCCI
+5V C26
R16
U19
LOWER*
VCCI
+5V C27
R17
U20
HIGHER*
VCCI
-5V C28
R18
U21
RST
TP8
EXT LOAD
+5V
CR10
U22
CR9
+5V
C32
+5V
C33
CD
CU
RST
LOAD
U24
BR
CD
CU
RST
LOAD
U25
TP0
TP1
TP2
TP3
TP7
TP6
TP5
TP4
U22
+5V

FIG. 5e

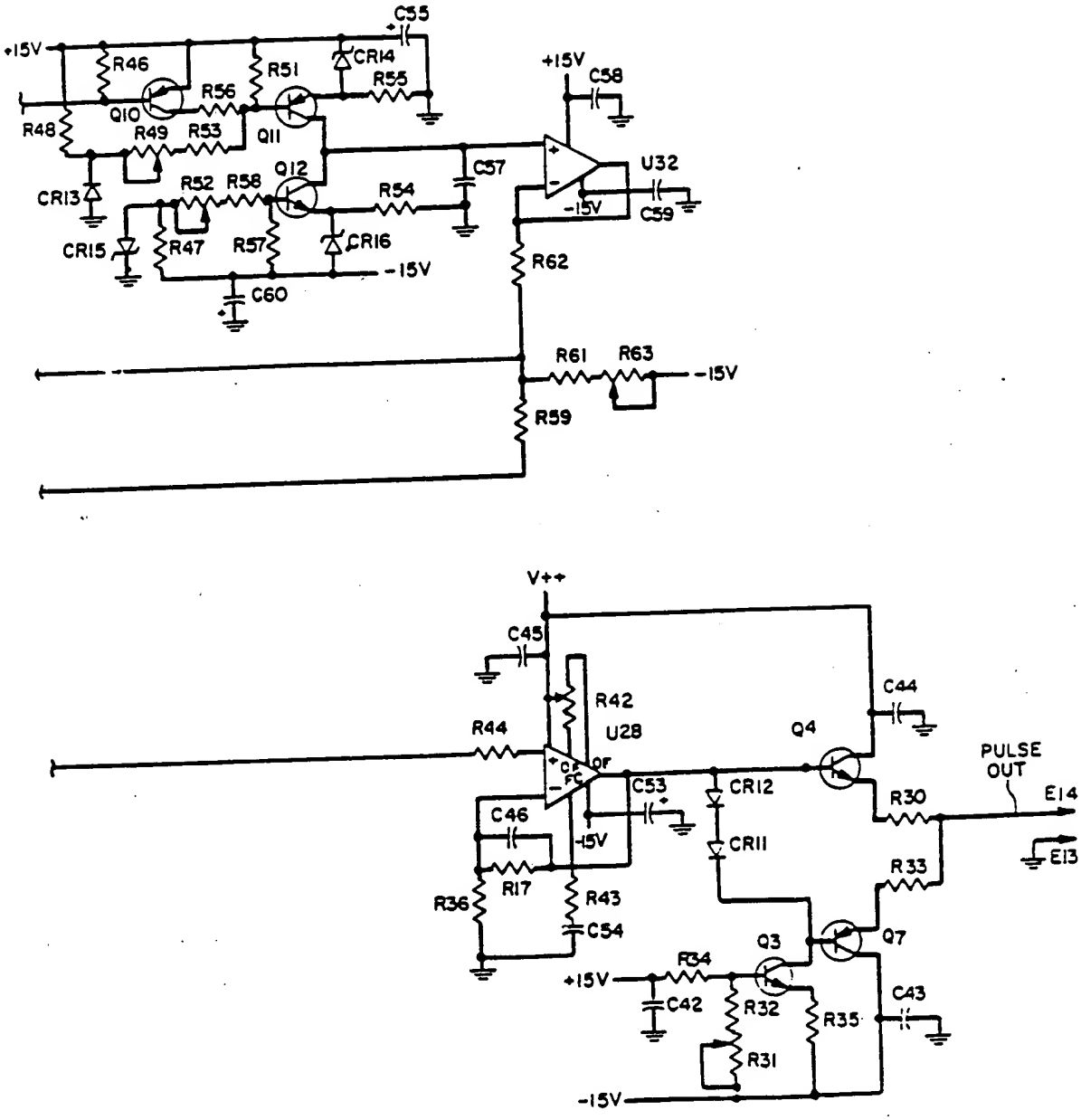

C55
+15V
R46
CR14
R51
R55
+15V
C58
Q10
R56
R48
R49
R53
Q11
U32
C57
Q12
R52
R58
R54
CR13
-15V
C59
CR15
R47
R57
CR16
-15V
R62
C60
R61
R63
-15V
R59
V++
C45
R42
C44
R44
U28
Q4
PULSE OUT
E14
C53
CR12
R30
C46
-15V
CR11
E13
R33
R17
R43
R36
C54
Q3
Q7
R34
+15V
C42
R32
R35
C43
R31
-15V

FIG. 6a

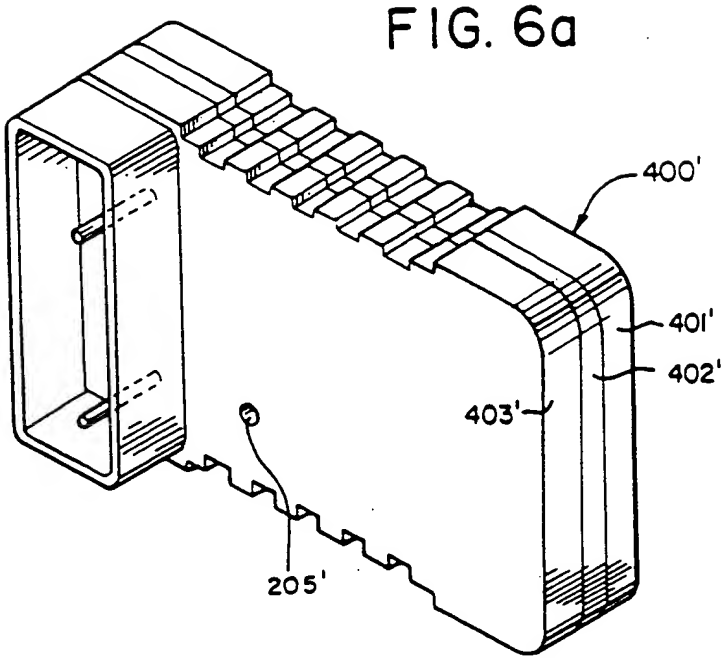


FIG. 7

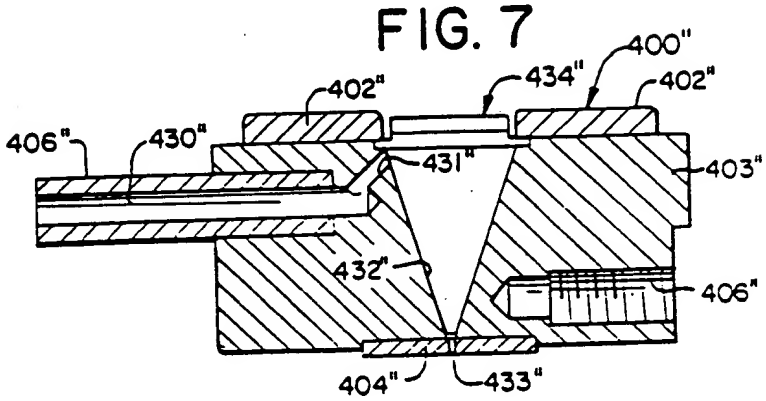
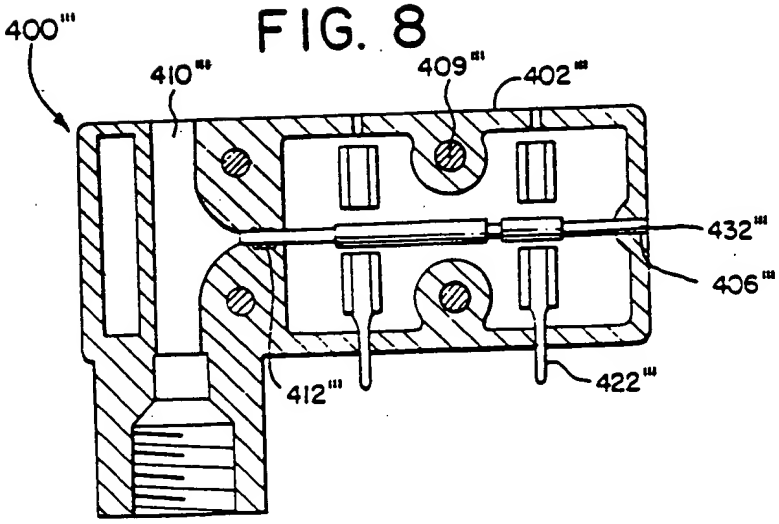


FIG. 8



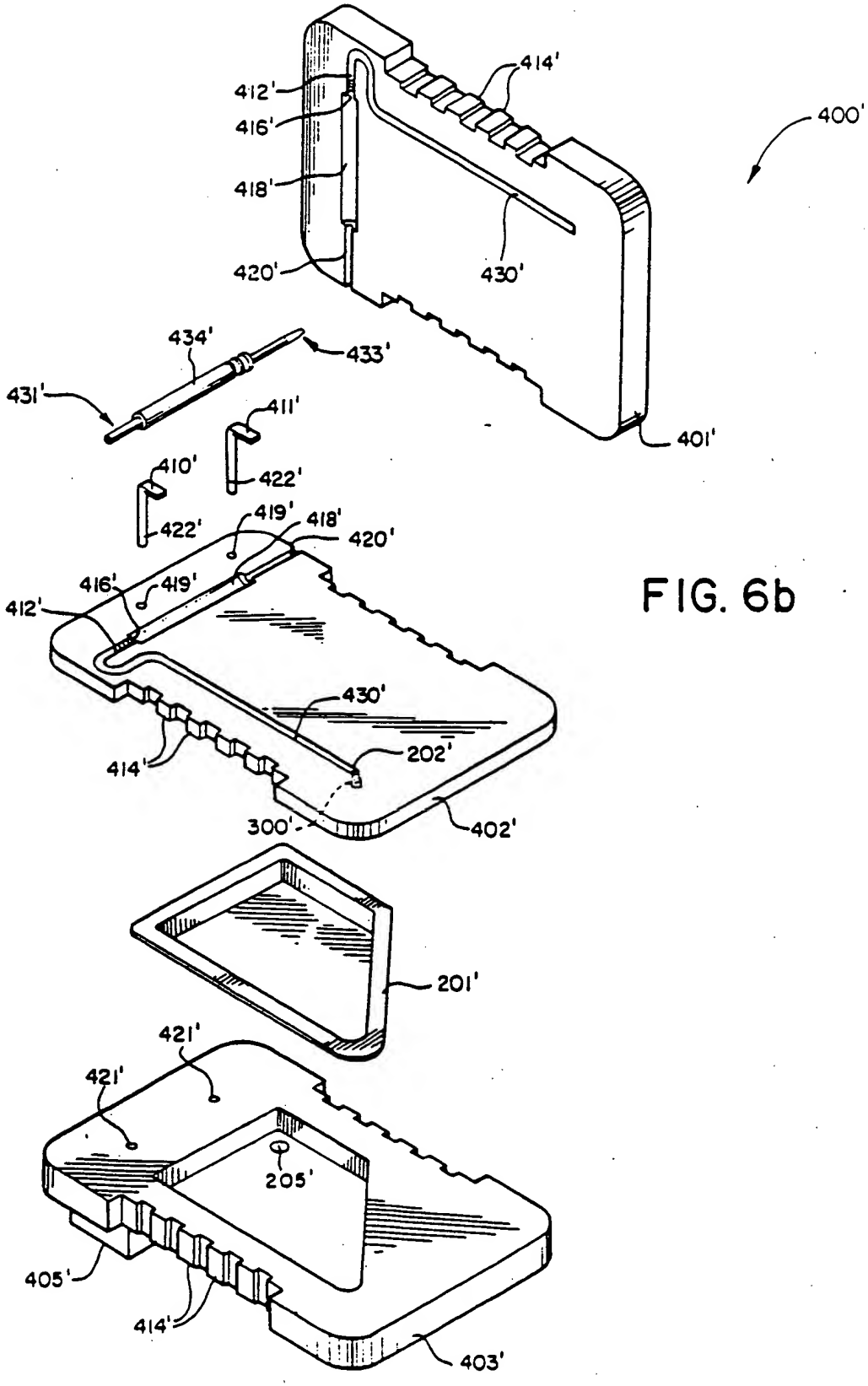

400'
414'
412'
416'
418'
420'
430'
401'
434'
433'
431'
411'
410'
422'
422'
419'
418'
420'
416'
419'
412'
430'
414'
202'
300'
402'
201'
421'
421'
205'
405'
414'
403'

FIG. 6b

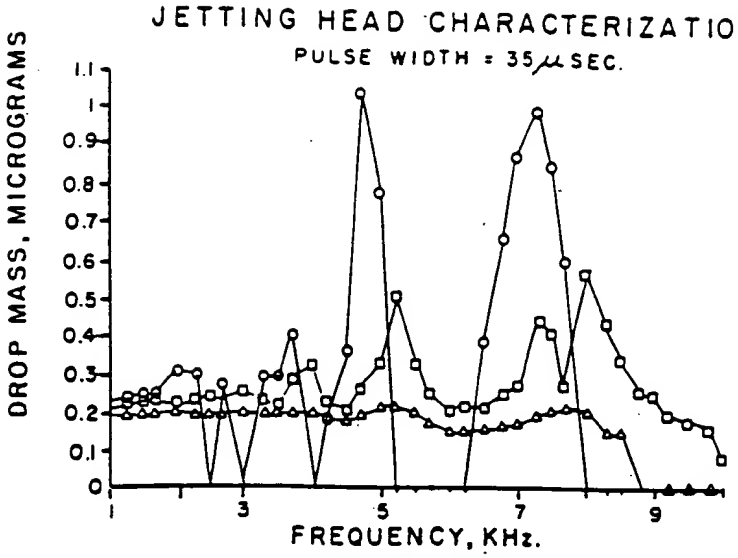


FIG. 9

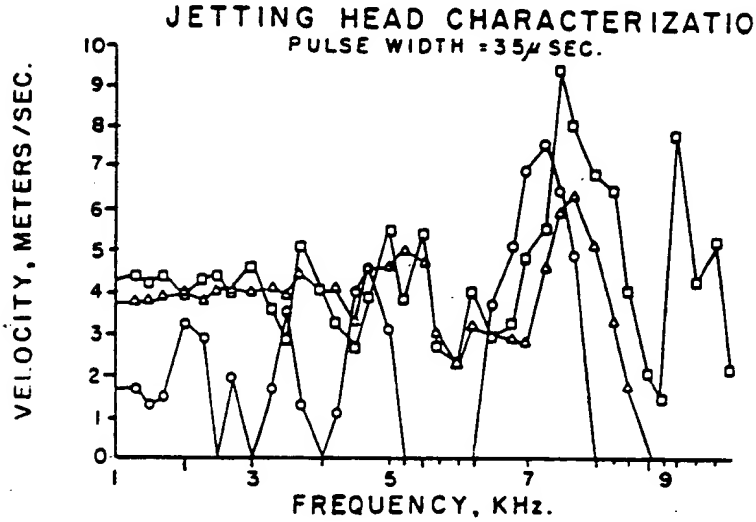


FIG. 10

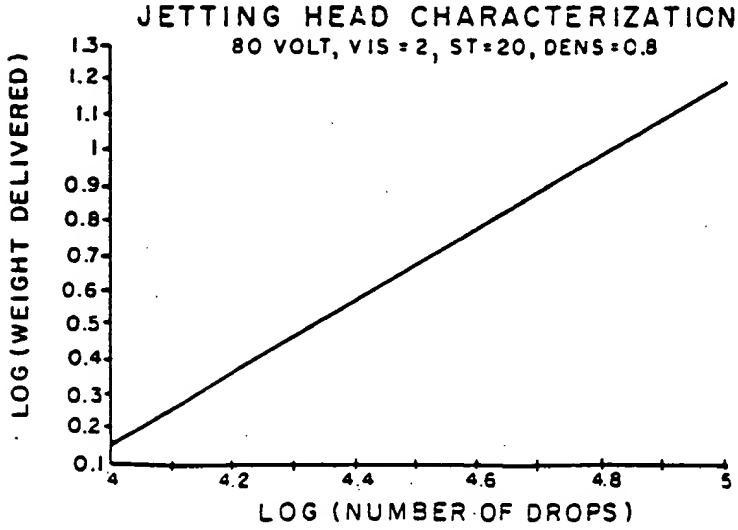


FIG. 11

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 268 237 A3**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 87116861.3

(22) Date of filing: 16.11.87

(51) Int. Cl.4: G01N 1/10 , G01N 35/00 , G01F 11/02

(30) Priority: 17.11.86 US 931476

(43) Date of publication of application:
25.05.88 Bulletin 88/21

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(88) Date of deferred publication of the search report:
30.11.88 Bulletin 88/48

(71) Applicant: ABBOTT LABORATORIES
Abbott Park Illinois 60064(US)

(72) Inventor: Hayes, Donald J.
2012 Tampicko Drive
Plano Texas 75075(US)
Inventor: Wallace, David B.
9929 Wood Forest
Dallas Texas 75243(US)
Inventor: Verlee, Donald J.
563 Drake Street
Libertyville Illinois 60048(US)
Inventor: Houseman, Kenneth R.
1520 S. Main Street
Racine Wisconsin 53403(US)

(74) Representative: Modiano, Guido et al
MODIANO, JOSIF, PISANTY & STAUB
Modiano & Associati Via Meravigli, 16
I-20123 Milan(IT)

(54) Apparatus and process for reagent fluid dispensing and printing.

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube (432), comprising an orifice (433) at one end and a fluid receiving aperture (431) at the other end, is concentrically mounted within a cylindrical piezoelectric transducer (434). The fluid receiving aperture (431) is connected to a reservoir (200) containing a selected reagent by means of a filter (300). The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer (434) and the volume defined by the jetting tube (432) to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer (434) and the volume of the jetting tube (432) to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice (433). The droplet may be directed to impact a printing medium or collected in a dispensing recepticle.

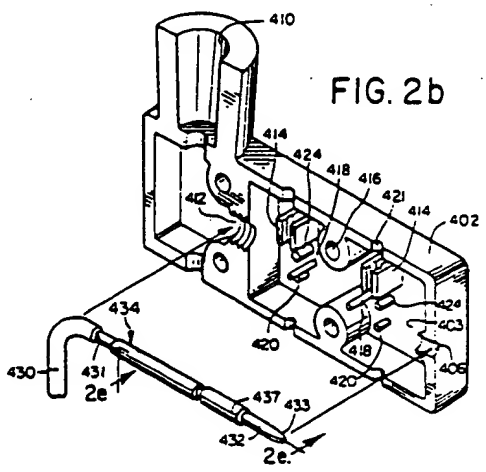


FIG. 2b

EP 0 268 237 A3

Europäisches Patentamt

EUROPÄISCHER RECHERCHENBERICHT

Nummer der Anmeldung

EP 87 11 6826

EINSCHLÄGIGE DOKUMENTE

Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int. Cl.4)
A	US-A-2 459 581 (F.G. OSWALD) * Ansprüche 1,7; Seite 1, Spalte 1, Zeilen 1-33 * ---	1-8	C 08 G 63/48 C 08 G 63/66 C 09 D 3/64
A	PATENT ABSTRACTS OF JAPAN, Band 9, Nr. 119 (C-282)[1842], 23. Mai 1985; JP-A-60 8312 (DAINIPPON INK KAGAKU KOGYO K.K.) 17-01-1985 * Zusammenfassung * ---	1-4	
A	US-A-3 830 763 (J. GILLIAN et al.) * Ansprüche 1-4; Zusammenfassung * ---	1-8	
A	EP-A-0 167 962 (HENKEL KOMMANDITGESELLSCHAFT AUF AKTIEN) * Ansprüche 1-11 * ---	1-8	
A	DE-C- 859 952 (DUGUSSA) * Ansprüche 1,2 * ---	1-4	
A	FR-A-2 372 201 (MITSUBISHI) * Ansprüche 1-6 * -----	1	RECHERCHIERTE SACHGEBIETE (Int. Cl.4) C 08 G C 09 D

Der vorliegende Recherchenbericht wurde für alle Patentansprüche erstellt

Recherchenort	Abschlußdatum der Recherche	Prüfer
DEN HAAG	11-11-1988	DECOCKER L.

KATEGORIE DER GENANNTEN DOKUMENTE

X : von besonderer Bedeutung allein betrachtet
Y : von besonderer Bedeutung in Verbindung mit einer anderen Veröffentlichung derselben Kategorie
A : technologischer Hintergrund
O : nichtschriftliche Offenbarung
P : Zwischenliteratur

T : der Erfindung zugrunde liegende Theorien oder Grundsätze
E : älteres Patentdokument, das jedoch erst am oder nach dem Anmeldedatum veröffentlicht worden ist
D : in der Anmeldung angeführtes Dokument
L : aus andern Gründen angeführtes Dokument

& : Mitglied der gleichen Patentfamilie, übereinstimmendes Dokument

EPO FORM 1503 03.82 (P0403)